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(54) INK JET RECORDER AND INK JET RECORDING HEAD

(57)Abstract:

PURPOSE: To miniaturize the title apparatus and to record an image of which color or density unevenness is suppressed by a method wherein a plurality of ejection nozzle arrays each of which ejects different kind of ink having different density or color are integrally provided by being aligned in a direction different from a head movement direction.

CONSTITUTION: In an (N+1)th line, recording of a high density black color Kk, a high density yellow Yk and LF are executed at the second scanning, recording of a high density cyan color Ck, a low density cyan color Cu and LF are executed at the third scanning and recording of a high density magenta color Mk, a low density magenta color Mu and LF are executed at the fourth scanning, thus one line of image is accomplished by three times of scannings. Recording of a high density yellow color and a high density black color is executed on the first scanning position at the second and fourth scannings so that in the case of using two arrays of ink jet units, recording of 64 dots that are twice the number of dots of magenta or cyan, is executed at one time. In this manner, the ink jet unit wherein a liquid chamber is divided and ink ejection nozzles each of which ejects different color are provided on an identical nozzle forming face so that the number of the recording heads or ink cartridges can be reduced and the apparatus can be miniaturized.



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CLAIMS

[Claim(s)]

[Claim 1] The aforementioned recording head is an ink-jet recording device characterized by equipping the aforementioned main scanning direction with two or more delivery trains for carrying out the regurgitation of the ink of concentration in which each differs in the ink-jet recording device which records on a record medium-ed by breathing out ink in the different direction from the recording head concerned at one using the recording head for carrying out the regurgitation of the ink, moving this recording head to main scanning direction.

[Claim 2] The aforementioned recording head is an ink-jet recording device according to claim 1 characterized by having two or more delivery trains for carrying out the regurgitation of the ink of different concentration for every ink of a different color the account of before.

[Claim 3] The aforementioned recording head is an ink-jet recording device according to claim 2 characterized by equipping the aforementioned main scanning direction with two or more delivery trains which it has for every ink of a different color in the different direction at one the account of before.

[Claim 4] The aforementioned recording head is an ink-jet recording device according to claim 2 characterized by equipping one with two or more delivery trains which it has for every ink of a different color at the aforementioned main scanning direction the account of before.

[Claim 5] The aforementioned main scanning direction is an ink-jet recording device characterized by to have arranged two or more delivery trains for carrying out the regurgitation of the ink of a color in which it arranges from the recording head concerned in the direction in which the aforementioned recording heads differ in the ink-jet recording device which records on a record medium-ed by breathing out ink, and each differs to the aforementioned main scanning direction for every concentration of ink, and to equip one with them, moving this recording head to main scanning direction using the recording head for carrying out the regurgitation of the ink.

[Claim 6] For the main scanning direction concerned, each of two or more delivery trains which carry out the regurgitation of the ink of different concentration or a color different the account of before is an ink-jet recording device according to claim 1 to 5 characterized by being arranged so that a part of delivery train concerned may overlap a part of other delivery trains in a different direction the account of before.

[Claim 7] For the main scanning direction concerned, each of two or more delivery trains which carry out the regurgitation of the ink of different concentration or a color different the account of before is an ink-jet recording device according to claim 1 to 5 characterized by setting other delivery trains and predetermined intervals and being arranged in a different direction the account of before.

[Claim 8] The aforementioned ink-jet recording device is an ink-jet recording device according to claim 1 to 7 characterized by performing operation which it has [operation] a cap for covering two or more deliveries of the aforementioned recording head, and performing ink suction, and relative displacement of the aforementioned recording head and the aforementioned cap is performed [operation] at the time of the aforementioned ink suction, and produces a crevice among recording heads and caps concerned.

[Claim 9] In the ink-jet recording device which records on a record medium-ed by breathing out

ink from the recording head concerned using the recording head for carrying out the regurgitation of the ink while moving this recording head to main scanning direction. The aforementioned recording head is a delivery train which comes to arrange two or more deliveries for carrying out the regurgitation of the ink in the direction in which the aforementioned main scanning direction differs. Two or more delivery trains which carry out the regurgitation of the ink of concentration in which it arranges in the different direction from the aforementioned main scanning direction, and each differs. It arranges and prepares for the aforementioned main scanning direction for every color of the ink concerned. all the pixels of a field recordable by one horizontal scanning of the aforementioned recording head. It thins out according to two or more infanticide array patterns which have the relation of a complement mutually. The ink-jet recording device characterized by what is recorded by performing relative displacement of the multiple times of the aforementioned recording head of a direction and the aforementioned record medium-ed which are different from horizontal scanning of the multiple times of the aforementioned recording head, and this horizontal scanning in the thinned-out picture.

[Claim 10] In the ink-jet recording device which records on a record medium-ed by breathing out ink from the recording head concerned using the recording head for carrying out the regurgitation of the ink while moving this recording head to main scanning direction. The aforementioned recording head is a delivery train which comes to arrange two or more deliveries for carrying out the regurgitation of the ink in the direction in which the aforementioned main scanning direction differs. Two or more delivery trains which carry out the regurgitation of the ink of a color in which it arranges in the different direction from the aforementioned main scanning direction, and each differs. It arranges and prepares for the aforementioned main scanning direction for every concentration of the ink concerned. all the pixels of a field recordable by one horizontal scanning of the aforementioned recording head. It thins out according to two or more infanticide array patterns which have the relation of a complement mutually. The ink-jet recording device characterized by what is recorded by performing relative displacement of the multiple times of the aforementioned recording head of a direction and the aforementioned record medium-ed which are different from horizontal scanning of the multiple times of the aforementioned recording head, and this horizontal scanning in the thinned-out picture.

[Claim 11] The aforementioned recording head is an ink-jet recording device according to claim 1 to 10 characterized by making ink produce a foam using heat energy, and carrying out the regurgitation of the ink based on generation of this foam.

[Claim 12] The ink-jet recording head characterized by having arranged two or more deliveries which carry out the regurgitation of the ink of concentration in which each differs the delivery which carries out the regurgitation of the ink in the ink-jet recording head used for ink-jet record in the different direction from the move direction at the time of use of the ink-jet recording head concerned, and preparing for one.

[Claim 13] The aforementioned recording head is an ink-jet recording head according to claim 12 characterized by making ink produce a foam using heat energy, and carrying out the regurgitation of the ink based on generation of this foam.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] Especially this invention relates to the ink-jet recording head and ink-jet recording device for recording a picture using the ink in which concentration differs about an affiliated color about record of an ink-jet recording head and an ink-jet recording device.

[0002]

[Description of the Prior Art] What performs digital image record using the recording head by the ink-jet method as one of the image formation equipment (henceforth a recording device) as information management systems, such as a reproducing unit, and a word processor, a computer, and an information [in / those devices / further in connection with the spread of communication equipment] output means has spread quickly. In such a recording device, what used the so-called multi-nozzle head which accumulated two or more liquid routes which are open for free passage to an ink delivery and this as a record element is common because of improvement in recording rate.

[0003] Many diameter control systems of a dot which control the size of the dot density control system which controls the number of record dots per unit area by the record dot of fixed size, and expresses halftone as a method, or a record dot which expresses halftone in the recording device of this method, and express halftone are used.

[0004] Since the latter diameter control system of a dot has the restrictions with the complicated control needed generally for changing the size of a record dot delicately here, When an electric thermal-conversion element is used as an energy generation means to generate the energy with which it is rare to be used and is especially used for ink ****, the recording head using this element manufacture is comparatively easy, and since a delivery etc. can be allotted with high density, record of high resolution is possible — etc., although it has an advantage It is difficult to change the pressure exerted on ink in the case of ****, therefore since it is difficult to modulate the path of a record dot, it is rare to use the diameter control system of a dot. When the recording head of an ink-jet method is used from the above reason, it uses for a dot density control system in many cases.

[0005] On the other hand, as one of the typical things of the binary-ized technique of halftone expression used for the dot density controlling method, although there is a systematic dither method, this method has the problem that the number of gradation is restricted by the size of a dither matrix. That is, although it is necessary to enlarge matrix size in order to make [many] the number of gradation, when matrix size is enlarged, 1 pixel becomes large [the record picture which consists of one matrix], and there are problems, such as spoiling resolution.

[0006] On the other hand, there are conditional determination type dither methods, such as an error diffusion method, as another typical thing of the binary-ized technique. This is the method of changing a threshold in consideration of the circumference pixel of an input pixel to being the independent determination type dither method which the systematic dither method mentioned above makes binary using a threshold unrelated to an input pixel. The conditional determination type dither method represented by this error diffusion method has gradation nature and the good compatibility of resolution, and when a subject-copy image is a printing picture, the advantages,

like it is very rare to generate a moire pattern are in a record picture.

[0007] On the other hand, graininess tends to be conspicuous by the bright section of a record picture, and there is a problem that quality of image deteriorates, and this problem becomes remarkable in the low record picture of recording density especially.

[0008] Two or more recording heads which carry out the regurgitation of the ink in which concentration differs about the ink of the same color conventionally as what solves the problem of the above graininess, respectively are prepared, a halftone portion forms a record dot in the low ink (light ink) of concentration from the bright section of a picture, and the record method that dark space forms a record dot in ink with high concentration (dark ink) from a halftone portion is proposed.

[0009] Drawing 1 is the perspective diagram showing the important section of the color ink-jet recording device of the conventional example by the serial print method using the shade ink concerning the above-mentioned record method.

[0010] Keep predetermined distance from carriage 241 respectively, and arrange a recording head [carrying out the regurgitation of the light ink of recording head / carrying out the regurgitation of the dark ink of recording head / carrying out the regurgitation of the light ink of recording head / carrying out the regurgitation of the dark ink of recording head / carrying out the regurgitation of the light ink of recording head / carrying out the regurgitation of the dark ink of recording head Ku, and cyanogen / Ck, and cyanogen / Cu, and a Magenta / Mk, and a Magenta / Mu, and yellow / Yk Carriage 241 is made to carry out both-way movement along with the above-mentioned guide shaft 243 by the drive of the carriage motor 245 which guidance support of the sliding of was enabled by the guide shaft 243, and minded the driving belt 244.

[0011] the liquid route which is open for free passage to the ink delivery of each recording head — ink **** — business — **** — heat energy — it is prepared in the heater element (electric thermal-conversion element) to generate

[0012] The ink used by each recording head is stored by the ink cartridge 248 prepared corresponding to each color, and is supplied through each ink supply path. Moreover, a transfer of the control signal from the device control section to a recording head or a driving signal is performed through the flexible cable 249.

[0013] With the conveyance roller (un-illustrating) and the delivery roller 242 which make a non-illustrated conveyance motor a driving source, the recorded material which consists of a record form, plastics sheet metal, etc. is conveyed in the direction of the arrow in drawing, and record is made and it goes to the field which counters with movement of each recording head in the meantime. That is, according to the reading timing of an encoder (un-illustrating) which detects the move position of carriage 241, the above-mentioned heater element is driven based on a record signal, and a picture can be recorded for an ink drop by the regurgitation and making it adhere on a recorded material in order of each ink of ** of black, **, ** of cyanogen, **, ** of a Magenta, **, ** of yellow, and **.

[0014] The recovery unit 246 with the cap section 247 is arranged in the home position set up outside the record section by movement of carriage 241, and the ink regurgitation property of each recording head is stabilized by the regurgitation recovery by this recovery unit.

[0015]

[Problem(s) to be Solved by the Invention] as [show / below / although the ink-jet recording device using the conventional shade ink explained above solves the problem of the graininess in a record picture comparatively well and is one of the effective technique for the improvement in quality of image / recording device] — it divides roughly and there are two troubles

[0016] 1) Since the ink-jet recording device using conventional shade ink had prepared the recording head and the ink cartridge for every ink to be used, the problem that the increase of the number of recording heads and the number of ink cartridges and a recording device are enlarged is in the 1st.

[0017] Moreover, the weight of a recording head and carriage will also increase, the distance of the lamp up and down at the time of carriage movement becomes long, and equipment is enlarged similarly. Moreover, in order to make carriage drive by the above-mentioned weight increase, a load increases, the need of using the big drive motor of torque, and the need for the

complicated mechanism for the capping performance maintenance of a cap prepared according to the number of recording heads are produced, and there is a problem that the cost for it increases. [much]

[0018] Furthermore, since the number of recording heads increased, registration of each color recording head needed to be performed with a more sufficient precision, the expensive parts which made part precision high for the reason needed to be used, and complicated alignment adjustment and amendment control needed to be performed.

[0019] In addition, when recording using shade ink, and the difference of the dot concentration between shade ink is large, reappearance of gradation does not become alignment in the switch portions of light ink and dark ink in a record picture, but it is easy to produce a false profile. Moreover, there was also a problem from which change of the graininess of a picture and change of a color tone which were recorded occur in the above-mentioned ink switch portion, and serve as an unnatural picture. Although there is the method of recording by using low concentration ink, inside concentration ink, and high concentration ink etc. increasing the stage of concentration in order to solve such a problem, it is clear to promote the problem about above-mentioned size more.

[0020] 2) When using the ink in which concentration differs about each ink of two or more colors in the case of performing color record to the 2nd, there is a problem that the unevenness in the record picture which originated in each in order of the lap of the ink in which concentration differs in the sequence and the same color of a lap of each color ink etc. is easily uncancelable.

[0021] It is known that canceling concentration unevenness and the same thing can be used as the conventional technique of canceling the above-mentioned unevenness etc. This is explained below.

[0022] For example, in a color printer, various conditions, such as coloring nature, gradation nature, and uniformity, are needed in recording an image picture unlike what records only characters, such as a character printer. Especially slight dispersion for every delivery produced at the manufacture process of a multi-nozzle head about uniformity affects the discharge quantity of the ink of each delivery in the case of record, and the sense of a discharge direction, and becomes the cause of degrading picture grace as concentration unevenness of a record picture as a result.

[0023] The example is explained using drawing 2 and drawing 3.

[0024] In drawing 2 (A), 91 is the so-called multi-nozzle head, and since it is easy, it shall be constituted by eight deliveries 92 which carry out the regurgitation only of one kind of ink of monochrome and single concentration. 93 is the ink drops let breathed out from each delivery 92, as shown in this drawing, the ink drops let 93 is the same discharge quantity, and it is an ideal to be breathed out in the same direction. And if such regurgitation is performed, as shown in drawing 2 (B), the dot of a size equal on space will be recorded and the uniform picture which does not have concentration unevenness on the whole will be acquired (refer to drawing 2 (C)).

[0025] However, as stated also in advance in fact, there is many dispersion for every delivery, respectively, as shown in drawing 3 (A), dispersion arises in the amount and direction of ink drops which are breathed out from each delivery, and the size of a record dot and dispersion of an impact position as shown in drawing 3 (B) arise. Consequently, the portion of the blank paper which cannot fill area factor 100% along with the main scanning direction of a recording head exists, a dot overlaps reverse more than required, or a white muscle which is seen in the center of this drawing 3 (B) occurs. In this case, a concentration distribution becomes what is shown in drawing 3 (C), as a result, is the limitation usually seen by human being's eyes, and is sensed as concentration unevenness.

[0026] Moreover, when the amount of the ejection repeated for 1 time of every writing scan is not controlled uniformly, the same concentration unevenness etc. is produced. For example, when more ejections than a constant rate are made, it will be recorded on the position which the dot and dot of an edge of each scanning field separated from the amount of conventions, and the portion will be conspicuous as a white stripe. On the contrary, when an ejection is made fewer than a constant rate, the dots and dots of an edge will overlap more than required, and will be conspicuous as a black stripe. The more pixel density becomes high, when strict control is

required and this is not filled the more, the value of this amount of ejections will be connected on a record picture, and a stripe will generate it.

[0027] The following methods are proposed in order to prevent generating of the above concentration unevenness or a stripe.

[0028] Drawing 4 and drawing 5 explain the method. Although it is necessary to make a recording head 91 scan 3 times although the record section shown by drawing 2 and drawing 3 is completed, as shown in these views according to this method, the field equivalent to the half of the field, i.e., the half of the delivery array of a recording head, is completed by two scans. That is, after recording [by dividing eight deliveries of a recording head into two groups of upper 4 deliveries and lower 4 deliveries] the dot of four pixel trains using lower 4 deliveries, respectively by the 1st scan and carrying out the ejection for four deliveries in this case, in the 2nd scan, a dot is recorded on the portion on which the dot of the four above-mentioned pixel trains is not recorded using upper 4 deliveries. At this time, by each two scan, the dot which should be recorded by two scans is thinned out by the abbreviation half, and the dot recorded by each scan has a complementary relation. Below, such a recording method is called the division recording method.

[0029] Since the influence on the record picture for every delivery will be reduced by half even if it uses the recording head which has dispersion in a regurgitation property for every delivery as shown by drawing 3 if such a division recording method is performed, the recorded picture comes to be shown in drawing 4 (B), and a black stripe and a white stripe which are seen to drawing 3 (B) stop being so much conspicuous. Therefore, as concentration unevenness is also shown in drawing 4 (C), as compared with the case of drawing 3 (C), it is eased considerably. Moreover, if this division recording method is performed, since the dot of 1 pixel train will be recorded by the delivery of a recording head edge, and the delivery of a recording head center section, the bond stripe produced on the boundary of each scanning field can also be reduced by half.

[0030] Although it divides by 1 scan eye and 2 scan eye so that it may compensate for image data mutually according to the regular array with a dot (complementary) in case such record is performed, as shown in drawing 5, as for this image data division (henceforth an infanticide pattern), it is usually most common that a dot uses what becomes a hound's-tooth check exactly for 1 pixel of every direction. Therefore, record is completed by 1 scan eye which records a hound's-tooth check in a unit record section (here 4-pixel unit), and 2 scan eye which records a reverse hound's-tooth check.

[0031] It explains how record of a fixed field is completed and drawing 5 (A), (B), and (C) go, when alternate [this] and a reverse alternate pattern are used, respectively. By 1 scan eye, the dot 51 which forms an alternate pattern using lower 4 nozzles is recorded first (drawing 5 (A)). Next, after performing an ejection by 4 pixels (1/2 of head length), the dot 52 of a reverse alternate pattern is recorded by 2 scan eye (drawing 5 (B)). After performing a 4 pixels (1/2 of head length) ejection again, the dot 53 of an alternate pattern is again recorded on eye further 3 scans (drawing 5 (C)). Thus, the record section of a 4-pixel unit is completed for every scan by performing record of the ejection of a 4-pixel unit, and a 1000 birds and a reverse alternate pattern by turns one by one. As explained above, when recorded by two kinds of deliveries from which the dot of the same pixel train differs, it becomes possible to equalize the influence of dispersion in the **** property for every delivery, and to acquire a high definition picture with little concentration unevenness.

[0032] Such a record method is already indicated by for example, JP,60-107975,A and a USP No. 4967203 official report, and the effective thing is stated to each to the concentration unevenness fellow calm stripe. It is indicated in the former, saying "It is characterized by having a means to make the ejection of each horizontal scanning fewer than the width of face of this horizontal scanning, to overlap two adjoining horizontal scanning, and to form a duplication portion, and a means to arrange the printing dot of this duplication portion so that it may not lap in two horizontal scanning." In this official report, although [an infanticide mask] it "1 Is **** alternately about odd level and even level every train", it may record at random by the case where even level is ****(ed) by odd level and the 2nd scan by the 1st horizontal scanning, and

each scan, and an infanticide mask and ejection width of face are not limited completely.

[0033] On the other hand, it sets in the latter USP No. 4967203 official report. "The pixel which printed the police box pixel position where only the upper half in the 1st band does not adjoin a level perpendicular direction with the a 1st path, and was not printed with the 1st path in the 1st band with the b 2nd path, The 1st path is performed on the band which continues immediately after at the same time it prints on the police box-pixel which does not adjoin the level perpendicular direction of the lower half in the 1st band and prints the pixel in the 1st and 1st band which were not printed with the 2nd path with the c 3rd path."

It is indicated. Thus, in this official report, the police box pixel array which does not adjoin a perpendicular horizontal direction as an infanticide mask which performs division record is limited.

[0034] As composition further added in this official report, several pixels are summarized for gradation expression or multicolor expression, a false pixel (super pixel) is formed, and the recording method for performing the police box infanticide print which does not adjoin a level perpendicular direction per false pixel (super pixel) is indicated. And once it incorporates the system for realizing the "above-mentioned method according to this method in which of program software or printer form wear the quality of this print is attained, without complicating recklessly the work which creates the computer program for making much colors, since a program can be called by the color number of the combination specified about the super pixel It is described as " and the simplification of programming for multicolor expression is also raised as an effect.

Moreover, since it has the intention of each super pixel being perceived as single homogeneous color, it is said that bleeding of the color within a super pixel is harmless.

[0035] By the way, in order to raise recording rate in the conventional printer of composition of putting the recording head of two or more colors in order in the direction of a writing scan, when performing both-directions record and not using the above-mentioned division recording method, an irregular color etc. may be generated simultaneously with generating of the unevenness mentioned above. Hereafter, the reason is explained.

[0036] The impact state to the record medium-ed of the record ink currently used for general present (paper) is shown in the cross section of drawing 6 . Here, the case where the position which set time difference and almost adjoined is made to absorb the ink (dot) of two different colors (record) is shown. Notes are that the direction of the dot struck after the dot recorded previously is in the inclination which sinks in the depth direction of space in a 2-dot lap portion. This is the stage combined as physically [coloring matter, such as a color in the breathed-out ink,] as a record medium-ed, and chemically. In the limitation which does not have a big difference in bonding strength by the kind of coloring matter since combination of a record medium-ed and coloring matter is limited It is because it is thought that the coloring matter remains to a recorded intermediation body surface mostly, and it is hard to combine the coloring matter of the ink struck later in a recorded intermediation body surface, and it sinks in the space depth direction and combines with it since priority is given to combination with the coloring matter of ink and the record medium-ed which were breathed out previously.

[0037] In this case, since a priority color will change with placing sequence of two kinds of ink similarly when two kinds of ink is recorded on this impact area, two colors which change with placing sequence will be expressed to human being's visual-sense property as a result. For example, when a green (cyanogen + yellow) picture is formed in a certain fixed field and ink is driven into each pixel in order of cyanogen and yellow, the cyanogen absorbed previously serves as a priority color, and serves as a strong green picture of coloring of cyanogen. On the contrary, when ink is driven in in order of yellow and cyanogen, the strong green picture of coloring of yellow will be acquired.

[0038] Here, since considering the case where both-directions record is performed the recording head of each color is arranged in the direction of a writing scan as shown, for example in drawing 1 , the order of placing of the ink recorded on an outward trip and the order of placing of the ink recorded in a return trip are reversed. Therefore, coloring of the dot recorded on an outward trip and coloring of the dot recorded in a return trip become a different thing. When the ejection for length of one delivery array for every writing scan usually performed is performed, it appears by

turns for every scan line, and two kinds of different color tones and different concentration serve as a big irregular color, and make quality of image deteriorate by the whole record picture in such the state.

[0039] However, it is conquerable by using the division recording method for having also mentioned such evil above. Namely, coloring of the dot recorded on an outward trip (drawing 5 (A), (C)) as drawing 5 explained by performing division record, Since coloring of the dot recorded in a return trip (drawing 5 (B)) can make it mostly intermingled a moiety every in a fixed field, on the whole, the difference of the coloring nature of both dots is equalized, and middle coloring is obtained similarly exactly in every record section.

[0040] The above-mentioned composition and the above-mentioned effect about coloring nature are already indicated by for example, the USP No. 4748453 official report. By setting to the 1st complement-record to the pixel located in each record section by turns at a level perpendicular direction by the writing scan divided into the 2nd (or more than it), although there is no limitation of the amount of ejections here When forming the color picture at the time of preventing beading of the ink on record media-ed, such as a transparency film By reversing the order of ink placing of a color mixture pixel by the 1st scan and the 2nd scan has described the effect that (both-way record) and color banding (irregular color) can be prevented. Since the main purposes are prevention of beading between each pixel in this official report, the pixels recorded by one scan have been characterized by not adjoining mutually in a level perpendicular direction.

[0041] In JP,58-194541,A according to this application people on the other hand "Carry out the parallel arrangement of two or more record element arrays of a book, and a both-way run is made to carry out in the direction which goes to the aforementioned record element array direct. While recording intermittently the dot of the number fewer than all the dots in at least each line of a record dot matrix, and one side of each train that should be recorded in the outward trip of the aforementioned horizontal scanning in performing horizontal scanning of dot matrix record By recording intermittently the dot of the remainder in at least each aforementioned line and one side of each train in the return trip of the aforementioned horizontal scanning It is indicating with the record method characterized by changing mutually the sequence of duplication of the record in the duplicate-record dot by two or more aforementioned record element arrays in the outward trip and return trip of the aforementioned horizontal scanning." There is no limit which makes the amount of ejections fewer than a part for the length of a record element array like the division record previously explained also in this official report, and it is considering the effect as prevention of picture degradation by color tone gap (irregular color) of the record picture based on the duplicate record (heavy record) of color ink. In this official report, since prevention of this color tone gap is the main purposes, there is no special limit of the dot position recorded by each scan, and the horizontal infanticide which is recorded only on lengthwise by turns in an example in addition to a checker (1000 birds, reverse 1000 birds), and the vertical infanticide repeated by turns only in a longitudinal direction are indicated.

[0042] Moreover, although not limited to a color printer, also in JP,55-113573,A, the composition which performs both-way record using an Aya ** (1000 bird, reverse 1000 birds) pattern is indicated. It aims at preventing that **** the dot which adjoins before it makes it there be no mark counterpart continuously and a **** dot gets dry the dot which adjoins in this official report by it, and dot distortion arises. Therefore, the infanticide mask as well as the above-mentioned USP No. 4748453 official report is limited the Aya ** here.

[0043] By the way, all of the official report of the three above-mentioned affairs aim at the irregular color at the time of both-way record, or prevention of beading. Therefore, the composition considering the concentration unevenness prevention resulting from dispersion in a delivery as one of the purposes of "making the amount of ejections during each scan below into the length of a delivery array" is not taken like the division recording method indicated by this application. Moreover, nothing is indicated also about the case where it records using two or more kinds of ink in which concentration differs.

[0044] Since the order of placing of an ink color can allot two kinds of reverse record pixels equally in a record section mutually if division record is performed in both-way record as explained above, the dissolution of an irregular color is also attained simultaneously with the

concentration unevenness dissolution resulting from dispersion in a delivery.

[0045] However, the phenomenon in which a dot fixing state changes with order of ink placing can say the same thing, when driving in in piles the ink in which not only the irregular color mentioned above but concentration differs. That is, when the dot of ink with high concentration is recorded previously, the concentration of the dot of **** becomes preferential and the picture with high concentration carried out distinctly is acquired. On the other hand, when ink with high concentration is recorded after the low ink of concentration was struck, the ink sinks into the surroundings of the low ink of concentration greatly, and the smooth and uniform picture which concentration does not have is acquired.

[0046] If two or more ink in which concentration differs further about two or more sorts of each ink in consideration of the graininess in a record picture is used when performing color record using two or more sorts of ink as explained above, in addition to the irregular color resulting from the stacking-order foreword between [various] ink, the shade unevenness resulting from the stacking-order foreword between shade ink will also be produced, and how depending on which these irregular colors and shade unevenness appear will become more various.

[0047] Conventional recording head Kk-Yu used when performing the above color records in the ink-jet recording device shown in drawing 1, if it explains in more detail is an array as shown in drawing 7. For this reason, the combination of how depending on which ** which becomes possible, and various ink including ** lap will become more various by the scan at the time of performing color record as compared with the case where ** and light ink are not used.

[0048] For this reason, it may not be enough even if it is going to equalize an irregular color and shade unevenness by only using the above-mentioned division recording method as mentioned above. Moreover, it originates in the area in which the ink driven into each pixel so that it may be mentioned later spreads, and an irregular color etc. may be unable to be canceled.

[0049] this invention solves the 1st and 2nd problems produced when using ** and light ink which were mentioned above, and it is small and it aims at offering the ink-jet recording device by which the unevenness in the record picture was suppressed.

[0050]

[Means for Solving the Problem] Therefore, it sets to the ink-jet recording device which records on a record medium-ed by breathing out ink from the recording head concerned while moving this recording head to main scanning direction in this invention using the recording head for carrying out the regurgitation of the ink. The aforementioned recording head is a delivery train which comes to arrange the delivery which carries out the regurgitation of the ink in the direction in which the aforementioned main scanning direction differs, and is characterized by having at one two or more delivery trains which carry out the regurgitation of NKU of the kind from which each differs in the different direction from the aforementioned main scanning direction.

[0051] Moreover, it sets using the recording head for carrying out the regurgitation of the ink to the ink-jet recording device which records on a record medium-ed by breathing out ink from the recording head concerned while moving this recording head to main scanning direction. The aforementioned recording head is a delivery train which comes to arrange the delivery which carries out the regurgitation of the ink in the direction in which the aforementioned main scanning direction differs. It has two or more delivery trains which carry out the regurgitation of the ink of a kind in which each differs in the different direction from the aforementioned main scanning direction. The aforementioned recording head and the aforementioned record medium-ed in the different direction from the aforementioned main scanning direction It is characterized by what only width of face fewer than the width of face to which two or more aforementioned delivery trains extend performs relative displacement, records a part of pixel recordable by one movement of the aforementioned main scanning direction of the aforementioned recording head by one aforementioned movement for this movement of every, and records the remainder of the pixel in which the aforementioned record is possible for by other aforementioned one movement.

[0052] Furthermore, it is characterized by having at one two or more delivery trains which carry out the regurgitation of the ink of a kind in which it is the delivery train which comes to arrange the delivery which carries out the regurgitation of the ink in the direction in which the move

directions at the time of the use concerned differ, and each differs in the different direction from the aforementioned move direction.

[0053]

[Function] Since two or more delivery trains which carry out the regurgitation of the ink in which kinds, such as concentration and a color, differ, respectively can be established in the different direction from the move direction of the recording head at one according to the above composition, the miniaturization of the recording head itself and the mechanism for moving this is attained.

[0054] Moreover, a field recordable by one movement is divided, and when dividing and recording the pixel of the division field of a parenthesis by movement of multiple times, sequence that the ink in which two or more above-mentioned kinds of recording head differ laps by arrangement of two or more above-mentioned delivery trains in a recording head can always be made equal.

[0055]

[Example] Hereafter, with reference to a drawing, the example of this invention is explained in detail.

[0056] Example 1 (recording device composition) drawing 8 is the block diagram showing the control composition of the color ink-jet recording device in one example of this invention.

[0057] It is reading optically about the manuscript picture according [on drawing and / a sign 1] to CCD etc. Or the picture input section which inputs a picture luminance signal (RGB) from a host computer, a video device, etc. is shown, and a sign 2 shows a control unit equipped with the various keys which direct a setup and recording start of various parameters. A sign 3 shows CPU which controls this whole recording device according to the various programs in the below-mentioned ROM. A sign 4 shows ROM which stores the program for operating this recording device according to a control program and an error-processing program etc. The I/O gamma translation table for referring to sign 4a by the processing of an I/O gamma conversion circuit mentioned later in this ROM4, The masking coefficient which refers to sign 4b by processing of the below-mentioned color-correction (masking) circuit, The shade distribution table for referring to the black generation which refers to sign 4c by the below-mentioned black generation and processing of a UCR circuit and a UCR table, and 4d of signs by processing of the below-mentioned shade distribution circuit, and sign 4e show the program group which stores various above-mentioned programs, respectively.

[0058] Moreover, a sign 5 shows RAM used as the work area in the case of the various program executions in ROM4, and momentary evacuation area at the time of error processing. And a sign 6 shows the processing section which performs picture signal processing mentioned later, and the sign 7 shows the printer section which forms a dot picture based on the picture signal processed in the picture signal processing section 6 at the time of record. Furthermore, a sign 8 shows the bus line which transmits the address signal in this equipment, data, a control signal, etc.

[0059] (Picture signal processing section) Next, the detail of the picture signal processing section 6 shown in drawing 8 is explained.

[0060] Drawing 9 is the block diagram showing an example of the circuit which constitutes the picture signal processing section 6 of this example.

[0061] The red transmitted from host equipment etc., green, and the picture luminance signals R, G, and B of each blue are inputted into the input gamma correction circuit 11, and are changed into cyanogen, a Magenta, and the picture concentration signals 21C, 21M, and 21Y of each yellow here. Color processing is performed in the color-correction (masking) circuit 12, and black generation and a UCR (lower color removal) circuit 13, and these signals are changed into cyanogen, a Magenta, yellow, and the new picture concentration signals 23C, 23M, 23Y, and 23K of black.

[0062] After, as for these picture concentration signals, the gamma correction was performed in the output gamma correction circuit 14, Picture concentration signal 25Ck corresponding to each ink of dark cyanogen with high color concentration, a dark Magenta, dark yellow, and dark black, 25Mk, 25Yk, 25Kk, and color concentration in the shade distribution circuit 15 A low, It can distribute to picture concentration signal 25Cu corresponding to each ink of light cyanogen, a

.. light Magenta, light yellow, and light black, 25Mu, 25Yu, and 25Ku.

[0063] Drawing 10 (A), (B), and (C) are the diagrams explaining the example of a shade distribution table, respectively.

[0064] For example, like this example, when the ink of the concentration of two sorts of shades is used, the translation table of drawing 10 (B) is used.

[0065] This table is set up as a picture concentration signal value and the optical reflection density value of the picture after record show proportionality linear relation. A picture concentration signal is changed into a dark ***** light signal based on this shade distribution table in a shade distribution circuit. ** — light — each picture concentration signal which was able to be distributed to each is made binary in the binary-ized circuit 6 In the printer section 7, this binary data is made into the regurgitation signal of each recording head, from the ink delivery which corresponds according to a signal value from each recording head, ink is breathed out and a color picture is recorded.

[0066] (Printer section) Drawing 11 is the perspective diagram showing the important section composition of the color ink-jet recording device in the example of this invention.

[0067] Ink-jet unit 40k for dark ink which has each delivery train which carries out the regurgitation of black, cyanogen, a Magenta, and the dark ink of each yellow to ink-jet unit 40u for light ink which has each delivery train which carries out the regurgitation of black, cyanogen, a Magenta, and the light ink of each yellow separately keeps predetermined distance from carriage 41 mutually, and is installed in it. The guidance directions of the sliding are enabled by the guide shaft 43, and carriage 41 is made to carry out both-way movement along with the above-mentioned guide shaft 43 by the drive of the carriage motor 45 through the driving belt 44.

[0068] The heater element (electric thermal-conversion element) which generates the heat energy used for the ink regurgitation is prepared in the liquid route which is open for free passage to the ink delivery of each recording head of the ink-jet units 40u and 40k.

[0069] Ink supply in the correspondence delivery train of each ink-jet units 40u and 40k is performed through a predetermined supply way from each ink cartridge 48u and 48k. The interior is divided by the wall and these ink cartridges 48u and 48k store the ink of each concentration of yellow, a Magenta, cyanogen, and black. Moreover, the control signal to the ink JIETO units 40u and 40k etc. is sent through the flexible cable 49.

[0070] With the conveyance roller (un-illustrating) and the delivery roller 42 which make a non-illustrated conveyance motor a driving source, the recorded material which consists of a record form, plastics sheet metal, etc. is conveyed in the direction of an arrow, and record is made and it goes to the field which counters with movement of each ink-jet unit in the meantime. That is, according to the reading timing of an encoder which detects the move position of carriage 41, the above-mentioned heater element is driven based on a record signal, and a picture can be recorded for an ink drop by the regurgitation and making it adhere on a recorded material in order of the dark ink color of each color, and a light ink color.

[0071] The recovery unit 46 with the cap section 47 is arranged in the home position of the carriage 41 set up outside the record section by movement of carriage 41. When not recording, the ink delivery forming face of the ink-jet units 40u and 40k which are made to move carriage 41 to a home position, and correspond with each cap of the cap section 47 is sealed, and the blinding by adhesion of foreign matters, such as fixing of the ink resulting from ink solvent evaporation or dust, etc. is prevented.

[0072] Moreover, the above-mentioned cap section 47 attracts ink from the time of performing empty regurgitation mode in which ink is made to breathe out to cap circles, or an ink delivery in order to cancel the poor regurgitation and blinding of a low ink delivery of record frequency, and in case regurgitation recovery of the ink delivery which started the poor regurgitation is performed, it is used. Moreover, by arranging a blade in a cap section adjoining position, it is also possible to clean the ink delivery forming face of an ink-jet unit.

[0073] In addition, by preparing partition in each boundary in a cap's 47 vertical direction, it can prevent the ink in which suction etc. was carried out with the up side shifting to the bottom, and, thereby, quality-of-image degradation by color mixture etc. can be prevented.

- [0074] (Ink-jet unit) Drawing 12 is the decomposition perspective diagram showing the composition of the ink-jet units 40u or 40k used for this example.
- [0075] The end of a circuit board 50 is mutually connected with the wiring portion of the heater board 51, and two or more pads for receiving the control signal from this device control section, a **** signal, etc. are further prepared in the other end of a circuit board 50. Thereby, the electrical signal from a main frame control section comes to be supplied to each electric thermal-conversion element.
- [0076] The metal support plate 52 which supports the rear face of a circuit board 50 at a flat surface also makes the bottom plate of an ink-jet unit. A pressure spring 53 presses elastically the field near the ink delivery of the fluting top plate 54 by the line, and, for the reason, has the hind legs of the couple in which a cross section receives the force of acting on the presser foot stitch tongue hooked using the clearance hole prepared in the portion bent and formed and base plate of the abbreviation configuration for U characters, and a spring, with a base plate. The pressure welding of a circuit board 50 and the fluting top plate 54 is carried out according to this spring force. Moreover, anchoring of the circuit board 50 to a base material is performed by attachment by adhesives etc.
- [0077] Four ink supply pipes 55 are formed corresponding to each ink of yellow, a Magenta, cyanogen, and black. The filter-56 is formed in the edge of the ink-supply pipe 55. The ink-feed-zone material 57 is manufactured by mould fabrication, and the passage led to each ink feed hopper of the fluting top plate 54 from a supply pipe 55 is formed. Fixation to the support plate 52 of the ink feed-zone material 57 is simply performed by making the holes 58 and 59 of a base material 52 carry out penetration projection of the two pins by the side of the rear face of the ink feed-zone material 57 (un-illustrating), respectively, and carrying out heat weld of this.
- [0078] Under the present circumstances, the crevice between the orifice-plate section 580 and the feed-zone material 57 is formed uniformly. An encapsulant is poured in from the up encapsulant inlet of the ink feed-zone material 57, it closes the crevice between the orifice-plate section 580 and the ink feed-zone material 57 at the same time it closes wire bonding, passes along the slot further established in the support plate 52, and closes completely the crevice between the orifice-plate section 580 and the support-plate 52 front-end section.
- [0079] Drawing 13 is the perspective diagram which looked at the fluting top plate 54 mentioned above from the heater board 51 side.
- [0080] The slot for common liquid rooms is established in yellow, a Magenta, cyanogen, and each four ink of black, each common liquid room is divided with Walls 60a-60c, and the feed hoppers 61a-61d for ink supply are formed in each common liquid room.
- [0081] Slots 62a-62c are established in the pressure-welding side with the heater board 51 in the walls 60a-60c which divide each [these] common liquid room. This slot is open for free passage with the periphery section of the fluting top plate 54. After carrying out the pressure welding of **** 54 to a heater board and sticking it on it, the periphery section is closed by the encapsulant, as mentioned above. Under the present circumstances, along the above-mentioned slot, the encapsulant permeates and the crevice between **** and a heater board is filled. Thus, a common liquid room is completely separable at the process same with having been used by the conventional recording head. The structure of this slot changes with physical properties of an encapsulant, and it is necessary to make it into the configuration corresponding to each.
- [0082] Thus, it becomes possible by dividing a common liquid room into plurality to supply ink which is different in each ink delivery.
- [0083] Drawing 14 (A) is the ** type view which looked at the ink delivery train of the ink-jet units 40u and 40k from the recorded material side.
- [0084] each with [as mentioned above in this example] yellow, a Magenta, cyanogen, and each ink delivery train of black to one — the object for dark ink, the object for light ink, and two ink-jet units 40u and 40k are used
- [0085] 70Yk of ink-jet unit 40k, 70Mk, 70Ck, and 70Kk show ***** which breathes out yellow, a Magenta, cyanogen, and the dark ink of each black.
- [0086] 71Yu of ink-jet unit 40u, 71Mu, 71Cu, and 71Ku show ***** which breathes out yellow, a Magenta, cyanogen, and the light ink of each black. The delivery train of each color has

32 deliveries in the pitch of 360 dots per inch (360dpi), and there is a space for 8 dots between each color of these deliveries train with the wall between common liquid rooms.

[0087] Drawing 15 is the ** type view showing the image formation process using the ink-jet unit shown in drawing 14 (A).

[0088] The following explanation explains the space between each color as what is not.

[0089] When its attention was paid to the N+1st line, after record by the dark black Kk and the light black Ku was performed by the 1st scan, Conveyance operation (it omits a line feed and Following LF) of the recorded material of the specified quantity is performed. The record and LF by dark cyanogen Ck and light cyanogen Cu are performed by the 2nd scan, the record and LF by dark Magenta Mk and light Magenta Mu are performed by the 3rd scan, the record and LF by the dark yellow Yk and the light yellow Yu are performed by the 4th scan, and the N+1st-line record is completed. The amount of LF after each scanning record is a part for a delivery array length of 32 pieces of the delivery train of each color (length which added a part for a space in practice), and the picture for 32 deliveries is recorded by four scanning records.

[0090] Drawing 14 (B) is drawing showing other examples of the ink-jet units 40u and 40k.

[0091] In this example, what has each ink delivery train of a dark Magenta, dark cyanogen, and dark black, and the thing which has each ink delivery train of a light Magenta, light cyanogen, and dark yellow are used into the same ink-jet unit.

[0092] In drawing 14 (B), 72Kk of ink-jet unit 40k, 72Mk, and 72Ck show the delivery train which carries out the regurgitation of black, a Magenta, and each cyano dark ink. moreover . 73Yk of ink-jet unit 40u, 73Mk, and 73Cu show the delivery train which carries out the regurgitation of yellow, a Magenta, and each cyano light ink.

[0093] With this composition, only dark ink uses the yellow ink in which the graininess of a dot is not so much conspicuous by the picture bright section since lightness is high, and the black ink in which graininess is not so much conspicuous since it is used only in the high concentration section of a picture.

[0094] In this composition, yellow is used for a shade distribution table and, as for black, drawing 10 (A), a Magenta, and cyanogen use drawing 10 (B). Moreover, the number of deliveries of other colors **** the number of deliveries of 72Kk and 73Yk, and it shines. In the delivery train of each color, **, a light Magenta, **, and the object for light cyanogen have 32 deliveries in the pitch of 360 dots per inch (360dpi), and dark black and the object for dark yellow have 64 deliveries. Moreover, there is a space for eight deliveries between each color with the wall of a liquid room.

[0095] Drawing 16 is the ** type view showing the image formation process at the time of using the recording head of this composition shown in drawing 14 (B).

[0096] If its attention is paid to the N+1st line, the record and LF by the dark black Kk and the dark yellow Yk will be performed by the 2nd scan, the record and LF by dark cyanogen Ck and light cyanogen Cu will be performed by the 3rd scan, the record and LF by dark Magenta Mk and light Magenta Mu will be performed by the 4th scan, and the N+1st-line record will be completed. The amount of LF after each scanning record is a part for 32 delivery column width, and image recording for 32 delivery trains is performed by three scanning records.

[0097] In addition, record of dark yellow and dark black is performed every other scan, and a part for 64 double deliveries is recorded at a time compared with a Magenta and cyanogen.

[0098] By carrying out like this composition, when performing a black character and monochrome record, there is an advantage which can make recording rate quick by making the amount of LF adjustable at a part for 64-dot width of face.

[0099] Drawing 14 (C) is drawing showing the example of composition of further others of an ink-jet unit.

[0100] In this example, the object for dark ink, the object for light ink, and two ink-jet units are used for the thing with yellow, a Magenta, cyanogen, and each ink delivery train of black in the same ink-jet unit. However, as for yellow and black, both the ink-jets unit is using dark ink.

[0101] In drawing 14 (C), 74Yk of ink-jet unit 40k, 74Kk, 74Mk, and 74Ck are ***** which breathe out yellow, black, a Magenta, and each cyano dark ink.

[0102] 75Mk of ink-jet unit 40u, ***** 75Kk to which 75Ck breathes out a Magenta and

each cyano light ink, and 75Yk are ***** which breathe out black and the dark ink of each yellow.

[0103] Since it is used like the composition described previously only in the high concentration section of the yellow ink in which the graininess of a dot is not conspicuous by the picture bright section since lightness is high, or a picture, only dark ink uses the black ink in which graininess is not conspicuous.

[0104] With this composition, drawing 10 (A), a Magenta, and cyanogen use drawing 10 (B) about yellow and black as a shade distribution table.

[0105] The delivery train of each color has 32 deliveries in the pitch of 360 dots per inch (360dpi), and there is a space for 8 dots between each color with the wall of a liquid room. Black and the delivery train for yellow are ****(ing) the number of deliveries of other colors by using two ink-jet units, and can record 64 dots simultaneously. Moreover, between yellow and black, a delivery train shifts and it is formed so that a blank may not arise.

[0106] Drawing 17 is the ** type view showing the image formation process at the time of using the ink-jet unit of composition of being shown in drawing 14 (C).

[0107] If its attention is paid to the N+1st line, the record and LF by the dark black Kk and the dark yellow Yk will be performed by the 2nd scanning eye, the record and LF by dark cyanogen Ck and light cyanogen Cu will be performed by the 3rd scanning eye, the record-and-LF-by-dark Magenta Mk and light Magenta Mu will be performed by the 4th scanning eye, and a picture will be completed by three scanning records. The amount of LF after each scanning record is a part for 32 delivery column width, and the picture for 32 delivery column width is recorded by three scanning records.

[0108] Record of dark yellow and dark black is performed every other scan of the 2nd scan and the 4th scan in the example shown in drawing, and 64 dots double by using the delivery train of two ink-jet units compared with a Magenta and cyanogen can be recorded at a time.

[0109] When performing a black character and monochrome printing like previous composition by carrying out like this composition, it is possible to make recording rate quick by carrying out adjustable [of the amount of LF] to a part for 64-dot width of face.

[0110] the above — also in which example of composition, in order not to record a total color at once in record process, a good picture also with little picture degradation by blot etc. is acquired Furthermore, in an actual ink-jet unit, since a space is between each color, the effect of the bond position of the writing scan of each color not being in agreement in each color like this illustration Ming, becoming a different position, and making generating of the bond line of a writing scan easing as a result is also acquired.

[0111] A liquid room is divided like this example, by using the ink-jet unit equipped with the ** ink delivery which breathes out the ink of a color which is different in the same delivery forming face, the number of ink-jet units (recording head) and the number of ink cartridges can be reduced, and the miniaturization of equipment is attained.

[0112] Moreover, since the ink-jet unit used for this example can manufacture the delivery train of a color which is different in the same delivery side often [precision] and at a low price, a high precision like equipment before and complicated amendment control become unnecessary, and low-pricing of it is also attained.

[0113] In addition, although it is more desirable for each color delivery train to arrange the ink-jet unit of this example on the same straight line from reduction-ization of ink *** timing amendment, it may arrange each color delivery train lining up side-by-side, without being limited to this example, or may arrange it alternately.

[0114] Moreover, as this example explained, improvement in recording rate is also attained by changing the number of deliveries for every color if needed.

[0115] Furthermore, although the ink cartridge of this example is carried on carriage like the ink-jet unit, you may make it supply ink to an ink-jet unit through an ink supply cube, without uniting with an ink-jet unit and carrying on carriage. Moreover, although the direction which used the cartridge which divides the interior like this example and has ink of two or more colors is desirable in respect of an equipment miniaturization, you may make it use the ink cartridge of a single color, without dividing the interior.

[0116] Modification 1 (printer section) drawing 18 of an example 1 is the perspective diagram showing the important section composition of the color ink-jet recording device in the modification 1 of the above-mentioned example 1. The same sign is given to the element shown in drawing 11, and the same element, and the explanation is omitted. Suppose that it is the same also in drawing 19 and drawing 20 which are shown below.

[0117] the object for black ink which has ***** which breathes out dark black ink, and ***** which breathes out light black ink in this example — with ink-jet unit 110K Ink-jet unit 110C for cyano ink which has ***** which breathes out dark cyanogen ink, and ***** which breathes out light cyanogen ink, the object for Magenta ink which has ***** which breathes out dark Magenta ink, and ***** which breathes out light Magenta ink — with ink-jet unit 110M With ink-jet unit 110Y for yellow ink which has ***** which breathes out dark yellow ink, and ***** which breathes out light yellow ink, predetermined distance is kept from carriage 41 and it is installed in the direction of a writing scan.

[0118] (Ink-jet unit) Drawing 19 is the decomposition perspective diagram showing the composition of the ink-jet units 110K, 110C, 110M, and 110Y used for this example, and is the same as that of the composition shown in drawing 12 almost except fluting top-plate 54.

[0119] Drawing 20 is the perspective diagram which looked at the fluting top-plate 54 of the ink-jet unit used for this example from the heater board 121 side. The common liquid room of this example is established in the object for dark ink, and two light ink, and each liquid room is divided with the wall 60. The feed hoppers 61a and 61b for ink being supplied are formed in each common liquid room.

[0120] Drawing 21 is drawing which looked at the ink delivery train of the above-mentioned ink-jet unit from the recorded material side. In this example, into the same ink-jet unit, it has each ink delivery train for the object for dark ink, and light ink, and an ink-jet unit is used corresponding to the ink of yellow, a Magenta, cyanogen, and black, respectively.

[0121] In drawing 21, 143Yu, 142Mu, 141Cu, ***** to which 140Ku breathes out light ink, 143Yk, 142Mk, 141Ck, and 140Kk are ***** which breathe out dark ink.

[0122] The delivery train corresponding to each shade ink has 64 deliveries in the pitch of 360 dots per inch (360dpi), and there is a space for eight deliveries between each color with the wall of a common liquid room.

[0123] Drawing 25 is the ** type view showing the image formation process at the time of using the ink-jet unit shown in drawing 21.

[0124] If its attention is paid to the N+1st line, the record and LF by dark black, dark cyanogen, the dark Magenta, and dark yellow will be performed by the 1st scan, the record and LF by light black, light cyanogen, the light Magenta, and light yellow will be performed by the 2nd scan, and the N+1st-line record will be completed by two scanning records. The amount of LF after each scanning record is a part for 64 delivery trains, and the picture for 64 delivery trains is recorded by two scanning records.

[0125] Drawing 22 is the ** type view showing other examples of composition of an ink-jet unit.

[0126] In this example, into the same ink-jet unit, it has each ink delivery train for the object for dark ink, the object for inside concentration ink, and light ink, and each ink-jet unit is used corresponding to each ink of yellow, a Magenta, cyanogen, and black. In this composition, a shade distribution table uses what is shown in drawing 10 (C).

[0127] In drawing 22, 153Yu(s), 152Mu, 151Cu, ***** to which 150Ku breathes out light ink, 153Ym, 152Mm, 151Cm, ***** that breathes out inside concentration ink 150km, 153Yk, 152Mk, 151Ck, and 150Kk are ***** which breathe out dark ink, respectively.

[0128] The delivery train corresponding to light ink has 64 deliveries in the pitch of 360 dots per inch (360dpi), and there is a space for 8 dots between each color into each ** with the wall of a common liquid room.

[0129] In this example, the record and LF by dark black, dark cyanogen, the dark Magenta, and dark yellow are performed by the 1st scan, the record and LF by inside black, inside cyanogen, the inside Magenta, and inside yellow are performed by the 2nd scan, the record and LF by light black, light cyanogen, the light Magenta, and light yellow are performed by the 3rd scan, and a

picture is completed by three scanning records. The amount of LF after each writing scan is a part for 32 delivery trains, and the picture for 32 delivery trains is recorded by three scanning records.

[0130] Like this composition, in addition to shade ink, it becomes impossible for a granular feeling to be conspicuous in a whole floor tone field by using inside concentration ink, each concentration ink can be changed further smoothly, generating of a false profile can also be prevented, and still smoother gradation reappearance is attained.

[0131] Drawing 23 is the ** type view showing the example of composition of further others of an ink-jet unit.

[0132] In this example, it is used combining a thing with each ink delivery train for the object for dark ink, and light ink, and a thing with the ink delivery of a single color in the same ink-jet unit.

[0133] In drawing 23 , the delivery train to which 162Mu(s) and 161Cu carry out the regurgitation of the light ink, respectively, 163Yk, 162Mk, 161Ck, and 160Kk are delivery trains which carry out the regurgitation of the dark ink. The number of deliveries of delivery train 160Kk and 163Yk is twice the number of deliveries of the delivery train of other colors.

[0134] Only dark ink is used about the yellow ink in which the graininess of a dot is not [a picture bright section] conspicuous since lightness is high, and the black ink in which graininess is not conspicuous since it is used only in the concentration section of a picture. In this composition, a shade distribution table uses [cyanogen / drawing 10 (A) a Magenta, and] what is shown in drawing 10 (B) about yellow and black.

[0135] Drawing 26 is the ** type view showing the image formation process at the time of using the ink-jet unit shown in drawing 23 .

[0136] In this drawing, if its attention is paid to the N+2nd line, the record and LF by dark black, dark cyanogen, the dark Magenta, and dark yellow will be performed by the 2nd scan, the record and LF by light cyanogen and the light Magenta will be performed by the 3rd scan, and a picture will be completed by two scanning records. The amount of LF after each scanning record is a part for 64 delivery trains, and can perform image recording for 64 delivery trains by two scanning records.

[0137] Record of dark yellow and dark black is only the 2nd scan among drawing, and is performed every other scan, and a part for 128 double delivery trains is recorded at a time as compared with a Magenta and cyanogen.

[0138] When performing a black character and monochrome printing like the above-mentioned example by carrying out like this composition, recording rate can be raised by making the amount of LF adjustable at a part for 128-dot width of face.

[0139] Drawing 24 is the ** type view showing the example of composition of further others of an ink-jet unit.

[0140] In this example, the unit which has the delivery train from which it has each ink delivery train for the object for dark ink and light ink in the same ink-jet unit, and ink discharge quantity differs is used.

[0141] In drawing 24 , the delivery train to which 173Yus, 172Mus, 171Cus, and 170Kus carry out the regurgitation of the small drop of the light ink of each color, 173Yul, 172Mul, 171Cul, and 170Kul are delivery trains which carry out the regurgitation of the large drop of the light ink of each color.

[0142] The delivery train to which 173Yks(es), 172Mks, 171Cks, and 170Kks carry out the regurgitation of the small drop of the dark ink of each color, 173Ykl, 172Mkl, 171Ckl, and 170Kkl are delivery trains which carry out the regurgitation of the large drop of the dark ink of each color.

[0143] The amounts of ink drops of a small drop are about 20 pl(s), and the amounts of ink drops of a large drop are about 40 pl(s).

[0144] Drawing 27 is the ** type view showing the image formation process at the time of using the ink-jet unit shown in drawing 24 .

[0145] If its attention is paid to the N+1st line, the record and LF by the small drop of dark black, dark cyanogen, a dark Magenta, and dark yellow will be performed by the 1st scan. The record and LF by the large drop of dark black, dark cyanogen, a dark Magenta, and dark yellow are

performed by the 2nd scan. The record and LF by the small drop of light black, light cyanogen, a light Magenta, and light yellow are performed by the 3rd scan, the record and LF by the large drop of light black, light cyanogen, a light Magenta, and light yellow are performed by the 4th scan, and the N+1st-line record is completed by four scanning records. The amount of LF after each scanning record is a part for 32 delivery trains, and can perform image recording for 32 delivery trains by 4 times of writing scans.

[0146] this composition — like — ** and light ink — adding — the diameter of a dot — ***** — by recording combining a thing, it stops being conspicuous in a granular feeling in a whole floor tone field, and further, the change of each concentration ink can carry out smoothly, and can also prevent generating of a false profile, and the still smoother gradation reappearance of it is attained

[0147] the above — also in which composition, like the above-mentioned example, in order not to record a total color at once, a good picture also with little picture degradation by blot etc. is acquired Furthermore, in an actual ink-jet unit, since a space is between the delivery trains of each color, the effect of becoming each position which did not carry out color coincidence but is different, and making generating of the bond line of a writing scan easing as a result is also acquired like this illustration Ming in the bond position of the writing scan of each color.

[0148] Moreover, according to the composition explained in this modification, the ink of a same color system can be packed in one ink-jet unit, and there is an effect also in share-izing of an ink cartridge, and relief of the color mixture which is easy to generate at the time of **** recovery action. Even if an ink lappet lump arises in suction operation by **** recovery action by arranging the delivery train of ink especially with low concentration (light ink) to the up side, and arranging ink with high concentration (dark ink) to the down side, ink color mixture can be prevented.

[0149] A common liquid room is divided, by using the ink-jet unit which equipped one with the ** ink delivery which breathes out the ink of a color which is different in the same delivery forming face, the number of ink-jet units (recording head) and the number of ink cartridges can be reduced, and the miniaturization of equipment also of this modification is attained the same by the previous example. Moreover, since the ink-jet unit used for this example can also form the delivery train of a color which is different in the same delivery side often [precision] and at a low price, a high precision like equipment before and complicated amendment control become unnecessary, and low-pricing of it is also attained.

[0150] In addition, also in the ink-jet unit of this example, although it is more desirable for each color delivery train to arrange on the same straight line from reduction-ization of ink **** timing amendment, each color delivery train may be arranged lining up side-by-side, without being limited to this example, or you may arrange alternately.

[0151] Moreover, as this modification explained, improvement in recording rate is also attained by changing the number of deliveries for every color if needed.

[0152] Furthermore, although the ink cartridge of this modification is carried on carriage like the ink-jet unit, you may make it supply ink to an ink-jet unit through an ink supply tube, without uniting with an ink-jet unit and carrying on carriage. Moreover, although the direction which used the cartridge which divides the interior like this example and has ink of two or more colors is desirable in respect of an equipment miniaturization, you may make it use the ink cartridge of a single color, without dividing the interior.

[0153] Modification 2 drawing 28 of an example 1 is the ** type view which looked at the ink-jet unit concerning other modifications of an example 1 from the recorded material side.

[0154] The ink-jet unit of this example establishes at one all the ink delivery trains corresponding to the total ink color used for record in the same ink-jet unit. ***** to which 210Yu breathes out the color ink of light yellow in the ink-jet unit 210, ***** to which 210Mu(s) breathe out the color ink of a light Magenta, ***** to which 210Cu breathes out the color ink of light cyanogen, ***** to which 210Ku(s) breathe out the color ink of light black, ***** to which 210Yk breathes out the color ink of dark yellow, ***** to which 210Mk(s) breathe out the color ink of a dark Magenta, ***** to which 210Ck breathes out the color ink of dark cyanogen, and 210Kk are ***** which

breathe out the color ink of dark black. Each color ink delivery train has a space for 8 dots with the wall of a common liquid room between the delivery trains of each color with 32 deliveries in the pitch of 360 dots per inch (360dpi).

[0155] The record and LF by dark black are performed by the 1st scan, and the record and LF by light black are performed by the 2nd scan. The record and LF by dark cyanogen are performed by the 3rd scan, and the record and LF by light cyanogen are performed by the 4th scan. The record and LF by the dark Magenta are performed by the 5th scan, the record and LF by the light Magenta are performed by the 6th scan, the record and LF by dark yellow are performed by the 7th scan, the record and LF by light yellow are performed by the 8th scan, and record of each line is completed by eight scanning records. The amount of LF after each scanning record is a part for 32 delivery trains, and can perform image recording for 32 delivery trains by 8 times of writing scans.

[0156] Also in this composition, like a previous example, in order not to record a total color at once, a good picture also with little picture degradation by blot etc. is acquired. Furthermore, in an actual ink-jet unit, since a space is between each color, the effect of becoming each position which did not carry out color coincidence but is different, and making generating of the bond line of a writing scan easing as a result is also acquired like this illustration Ming in the bond position of the writing scan of each color.

[0157] The ink-jet unit of this example can be built with a precision sufficient to the same delivery forming face by the ink delivery train of a total color, and does not have the problem of the registration gap between each color.

[0158] Moreover, although it is more desirable to arrange the **** timing between each color on [all] a color same straight line like this example since there is no amendment need, each ***** may be arranged lining up side-by-side, without being limited to this example, or you may arrange alternately.

[0159] Moreover, improvement in recording rate is also attained by changing the number of deliveries for every color if needed.

[0160] A common liquid room is divided, by using the ink-jet unit equipped with the ** ink delivery which breathes out the ink of a color which is different in the same delivery forming face, the number of ink-jet units (recording head) and the number of ink cartridges can be reduced, and the miniaturization of equipment also of this example is attained the same by each previous example. Moreover, an advanced equipment precision like equipment before and complicated amendment control become unnecessary, and low-pricing is also possible.

[0161] Although it is desirable to carry on carriage like an ink-jet unit as for a pen ink cartridge, you may make it supply ink to an ink-jet unit through an ink supply tube, without uniting with an ink-jet unit and carrying on carriage. Moreover, although the direction which used the cartridge which divides the interior and has ink of two or more colors is desirable in respect of an equipment miniaturization, you may make it use the ink cartridge of a single color, without dividing the interior.

[0162] Modification 3 drawing 29 of an example 1 shows the structure of the one apparatus ink-jet cartridge which assembled the ink-jet unit 224 of yellow, a Magenta, cyanogen, and black four colors each in one by the frame 220.

[0163] Since the previous example explains the composition of the ink-jet unit 224 in detail, it omits explanation here.

[0164] Four ink-jet units 224 are attached at the predetermined intervals in a frame 220, and where the registration of the direction of a delivery train is moreover also adjusted, they are fixed. 221 is covering of a frame and 222 is a connector for connecting the electrical signal from a pad and the main frame formed in the circuit board 120 of four ink-jet units 224. The circuit board 120 and the connector 222 are connected by the electrode 223.

[0165] Drawing 30 shows the situation when carrying the above-mentioned one apparatus ink-jet cartridge 222 in carriage.

[0166] It divides, and is divided into the room of two upper and lower sides by 230, and the ink tank 118 has filled up the lower room with dark ink for light ink in the upper room. And ink is supplied to the ink delivery train which pressure-welding combination of the ink-jet cartridge

222, and yellow, a Magenta, cyanogen and four ink tanks 118 of black is carried out on carriage, and corresponds from the ink tank 118.

[0167] Also in the ink-jet unit of this composition, like each previous example, in order not to record a total color at once, a good picture also with little picture degradation by blot etc. is acquired. Furthermore, in an actual ink-jet unit, since a space is between each color delivery train, the bond position of the writing scan of each color does not carry out each color coincidence, but the effect of becoming a different position and making generating of the bond line of a writing scan easing as a result is also acquired.

[0168] As for the one ink-jet cartridge of this example, it is possible for two or more ink delivery trains to put in order the ink-jet unit built with a precision sufficient to the same delivery forming face with a sufficient precision, and to really finish setting it up to a cartridge, it can solve the problem of the registration gap between each ink-jet unit, and the load of amendment control reduces it. Moreover, it is possible to communalize the electric contact section of each ink-jet unit, and the number of contacts with the main part of equipment can be reduced.

[0169] Although it is more desirable to arrange the **** timing between each color on [all] a color same straight line since each delivery train in an ink-jet unit does not have the amendment need, it may arrange each ***** lining up side-by-side, without being limited to this example, or may arrange it alternately, respectively.

[0170] Moreover, improvement in recording rate is also attained by changing the number of deliveries for every color if needed.

[0171] Furthermore, although it is desirable to carry on carriage like an ink-jet cartridge as for an ink cartridge, you may make it supply ink to an ink-jet cartridge through an ink supply cube, without uniting with an ink-jet cartridge and carrying on carriage. Moreover, although the direction which used the cartridge which divides the interior and has ink of two or more colors is desirable in respect of an equipment miniaturization, you may make it use the ink cartridge of a single color, without dividing the interior.

[0172] In addition, an advanced equipment precision like equipment before and complicated amendment control are attained by the miniaturization of equipment for it to be unnecessary, and this example as well as a previous example can also be fallen by the price.

[0173] In the example of four modifications of an example 1, the pixel position recorded by each writing scan is arranged so that it may become alternate about the pixel county of 1 x 2 pixels.

[0174] Hereafter, record of this example is explained with reference to drawing 31. In the 1st writing scan, the delivery in the lower half of [four] a light ink portion is used among the deliveries of a total of 16 pieces of an ink delivery train. At this time, the pixel array to record records the half which are all the pixels that are what made 1x2 pixels alternate, and can record the above-mentioned delivery (a pixel is thinned out and recorded on a half). After the 1st writing scan end, while, as for the recording paper, only 4-pixel width of face is sent in the direction of an arrow, a recording head unit is returned to a record starting position by the *****.

[0175] In the 2nd following writing scan, record is performed using the delivery of a total of eight pieces of light ink. At this time, the pixel recorded is the portion which arranged 1x2 pixels alternately similarly among the field of the 4-pixel width of face which was not recorded by the 1st writing scan, and the picture field of the 4-pixel width of face following this (infanticide contrary to the time of the 1st writing scan is performed).

[0176] After performing the ejection of 4-pixel width of face again and returning a recording head to a record starting position, the 3rd writing scan is performed. The delivery used here is a delivery of four lower halves the delivery of a total of eight light ink, and among dark ink delivery trains. The pixel array recorded at this time records the half which are all the pixels that are the same things as the time of the 1st writing scan which made 1x2 pixels alternate, and can record the above-mentioned delivery (a pixel is thinned out and recorded on a half).

[0177] All the deliveries of a recording head unit are used for the first time by the 4th following writing scan. The pixel which arranged 1x2 pixels alternately by infanticide contrary to the 3rd writing scan is recorded.

[0178] And all records to the 1st pixel record are completed by this writing scan.

- [0179] Hereafter, a picture is completed by repeating record similarly.
- [0180] ***** by the concentration unevenness by dispersion and record-medium conveyance unevenness of a regurgitation property and white **** can be made to ease by using the above division record methods, and a good picture can be offered.
- [0181] In the above-mentioned example, you may use an alternate infanticide pattern, without being limited to this, although the infanticide pattern which made 1x2 pixels alternate was used.
- [0182] Furthermore, the composition of a recording head unit is not restricted to this example, but can be applied to the thing of the above and all composition of that each example explained.
- [0183] In addition, the example of all above is an effective means also to a monochrome image not only like color picture record but gray-scale record.
- [0184] According to the example 1 explained above and its modification, in addition to the various effects mentioned above, the following effects can also be acquired.
- [0185] Since the delivery which carries out the regurgitation of the ink of a different kind, i.e., the ink of Y, M, C, and K, or the delivery which carries out the regurgitation of ** and the light ink about of-the-same-kind ink, respectively can be prepared in the same ink-jet unit as each above-mentioned example showed, register doubling between the record dots of each color or between the record dots of each shade becomes easy.
- [0186] Moreover, if it is in the composition which prepares ** which was mentioned above, and the delivery which carries out the regurgitation of light **, Inc. in the same ink-jet unit, since the operating frequency of the shade ink of these same system color is almost equal, exchange of the ink-jet unit which made the ink tank one can be performed, without making ink so useless.
- [0187] The example 2 shown below and its modification fully reduce the irregular color in the case of color record, shade unevenness, a stripe, etc. using the relation of the delivery array of each ink shown in an example 1 and its modification.
- [0188] Therefore, in the following examples, the ink-jet unit which does so the effect by unification of the delivery train of each ink by the example 1 and its modification can also be used, or only the relation of the delivery array of each ink is the same as that of example 1 grade, and the composition with which each delivery train is not united can also be used.
- [0189] In addition, in the example shown below, an example 1 or its modification should show an equipment configuration and control composition.
- [0190] Example 2 drawing 32 is the ** type view showing the composition of the ink-jet unit (henceforth a recording head) used for the example 2 of this invention.
- [0191] In this example, black (K), cyanogen (C), the Magenta (M), and the recording head which four colors each of yellow (Y) became independent of have a total of 16 deliveries of eight deliveries for dark ink regurgitation, and eight deliveries for light ink regurgitation, respectively. Delivery arrangement of each ink of this recording head is the same as that of the delivery arrangement shown in drawing 21, and can also make each delivery train one.
- [0192] The writing scan and ejection of a recording head are made in the direction shown by the arrow in drawing, and it is carried out by the width of face for four deliveries for every writing scan about an ejection. According to the composition of this example, since the recording paper is sent toward a dark ink record section from a light ink record section, after a light ink picture always completes record, a dark ink picture is recorded. Thus, if it is made the composition which arranges ** and the delivery train of light **, Inc. in one train in the direction of an ejection, since ** and the order of placing of light **, Inc. will not be reversed in the outward trip and return trip of both-directions record, the shade unevenness which originated in order of placing of ink can be prevented beforehand.
- [0193] Since it is characterized by to carry out division record using the recording head which carries out the regurgitation of the ink in which concentration differs further about each of two or more kinds of ink in which colors differ, in this example, the effect of division record can demonstrate also in the composition which the delivery train of the ink of all kinds as shown in drawing 7 has arranged in the direction of a writing scan. However, with such composition, irregular color evil is not yet solved in many cases completely.
- [0194] This reason is explained below using drawing 33 (A) and (B).
- [0195] Usually, the amount of ink drops let is designed so that it may spread greatly somewhat

rather than the area given to each pixel on space. This is for making it not seen [the portion of a blank paper] to the field of 100% of rates of printing. Therefore, although it is recorded about 50% of the number of record pixels when the division recording method is performed, as a record medium-ed (recording paper) is shown in drawing 32 (A), 50% or more of field will be covered. In addition, the amount of ink by which dark ink and light ink will be driven into per pixel if the dark ink and light ink of two or more colors are further recorded on the same pixel for color mixture record increases by 4 times, it oozes out and a field will be in the state almost near 100% (drawing 32 (B)). For this reason, even if it records an ink dot on the thinned-out pixel, since the first dot already occupies the portion, the concentration of the color of next ink does not become so high. Therefore, even when line record is both performed by division record, the picture field where the color tone of the scanning direction when being first recorded on space and concentration serve as [at] a priority color in the whole record section, and outward trip record turns into the first record, and the picture field where return trip printing serves as the first record serve as an irregular color by turns, it appears, and this degrades a picture in many cases remarkably.

[0196] In this example, the state of recording a uniform green picture is shown in drawing 34.

[0197] The uniform green picture said here is a picture on which cyanogen and yellow record both dark ink and light ink, and an input picture concentration signal points out the duty between 128 and 255 in the distribution table shown in drawing 10 (B). However, in the detail of the following containing this example, the state where the four above-mentioned sorts of ink was recorded on all pixels on account of explanation was set up.

[0198] In this example, the pixel position recorded by each writing scan is arranged so that it may become alternate about the pixel group of 1 x 2 pixels. By doing in this way, rather than the arrangement which makes alternate the 1-pixel unit shown by drawing 33, since it can ooze and ** can be decreased, a himself is devoted and already explained irregular colors by order other than the record pixel in each writing scan stop being able to happen easily.

[0199] Hereafter, in drawing 34, it explains briefly for every writing scan.

[0200] In the 1st writing scan, four deliveries in the lower half of a light ink portion are used among all 16 deliveries in a recording head. The pixel array recorded at this time is what made 1x2 pixels alternate, and records the half which are all the pixels that can record the above-mentioned delivery. In the 1st writing scan, since it records while a recording head scans in the direction of an outward trip, when recording a uniform green picture, ink is driven in in order of cyanogen and yellow to each record pixel. Therefore, in the pixel recorded by the 1st writing scan, a green picture with strong coloring of cyanogen will be acquired. As for the recording paper, only 4-pixel width of face is sent in the direction of the arrow in drawing after the 1st writing scan end.

[0201] In the 2nd following writing scan, all 8 deliveries of light ink are used in the direction of a return trip, and it is recorded on it. The pixel recorded at this time is the portion of the array which made 1x2 pixels alternate similarly among the field of the 4-pixel width of face which was not recorded by the 1st writing scan, and the picture field of the 4-pixel width of face following this. In the 2nd writing scan, since it is recorded in the direction of a return trip, the ink impact to a record pixel becomes the order of yellow and cyanogen. Therefore, in the pixel recorded by the 2nd writing scan, coloring of yellow serves as a strong green picture. However, since the ink of concentration recorded by the 1st and 2nd writing scans is thin from the first, there is no difference of the coloring nature by the order of ink placing what appears so greatly.

[0202] Again, the 3rd writing scan is performed in the direction of an outward trip after the ejection of 4-pixel width of face. The deliveries used here are four deliveries of a lower half among light ink all 8 deliveries and a dark ink delivery. since this writing scan is record of the direction of an outward trip again -- the [the 2nd and] -- in the light ink field of 3 picture field, it is cyanogen and the order of ink placing of the order of yellow, and a green pixel with strong coloring of cyanogen will be obtained On the other hand, in the 1st picture field, since printing in light ink will accomplish and the priority color will already be determined by light ink, even if dark ink is driven in in order of cyanogen and yellow, there is no determination of the priority color by this, and it is only that the concentration of green becomes high on the whole.

[0203] All the deliveries of a recording head are used for the first time to the 1st picture field by the 4th following writing scan. Since this writing scan is a return trip scan again, ink is driven in in order of yellow and cyanogen. Since it is the 1st picture field and record when it reached and light ink has already reached the target in the 2nd picture field as the 3rd writing scan explained, the order of ink placing of dark ink hardly influences a picture, but it is only that the concentration of green becomes high on the whole as for both the picture field. And by this writing scan, all records to the 1st picture field are completed. the [the 3rd and] — about 4 picture field, the priority color in a record pixel is determined like the old writing scan by the order of placing of ink

[0204] Like the following, using all 16 deliveries, an ejection scan and both-way record of 4 delivery trains are repeated successively, and it goes by each writing scan.

[0205] according to the method explained above, after making all the picture fields that stand in a row 4-pixel width of face every by using a recording head as shown in drawing 32 complete a light ink picture by the first two scans, the dark ink picture is completed by two continuing scans. Therefore, the factor itself in which shade unevenness like the conventional example appears also by the method of recording using shade ink will already be removed by this example.

[0206] On the other hand, about the irregular color of another evil by the order of ink placing, it has composition which records the dot of a color tone which is different in an outward trip and a return trip. however, the case of drawing 33 explained in the conventional example since the pixel recorded perform division record in this example, and simultaneous was made into 1x2 units — further — a another province region — it oozes and ** can be stopped. Therefore, an almost equal still better picture is acquired in each picture field in the rate of the area which the dot of the area which the dot recorded on the outward trip occupies recorded in the return trip occupies comparatively.

[0207] If based on such an idea, it can expect solving an irregular color and shade unevenness simultaneously also by the recording head of composition like the conventional example (drawing 7) by expanding further the pixel array now made into the size of 1x2. If it actually does in this way, surely the overall color tone in each picture field may become equal. However, if the unit of a pixel array is too large on the other hand, itself will come to be sensed visually shortly, a feeling of ZARATSUKI will appear on a picture, and it will become what smoothness lacked. Moreover, simultaneously, since a maximum of 400% or more of ink will be driven in to this pixel, a blot arises in the unique boundary section to it, and it will be easy to become not desirable in the high field of recording density to it.

[0208] this example is the delivery array composition of each ink color about the former, copes with it and is making two evils of the shade unevenness and irregular color which may happen in case both-directions record is performed solved by division record and pixel composition about the latter. And especially, by old explanation, after recording light ink previously, the head composition on which dark ink is made to record is taken. However, the order of placing of shade ink itself is not what was restricted to this. That is, it is a book even if it takes composition which reverses the position of a light ink nozzle and a dark ink nozzle.

[0209] Here, the picture comparison in the case of the recording head composition shown by drawing 32 which has so far explained, and composition of having reversed this composition and shade is explained briefly.

[0210] When light ink is recorded previously, a big dot with low concentration is obtained in a wraparound and each pixel by the light ink bottom in which the dark ink which reaches the target after that is already recorded. On the other hand, when dark ink is recorded previously, the dot of the priority color decided in the direction of a writing scan of the No. 1 beginning reaches the target by high concentration, and determines a priority color quite strongly. In this case, about an irregular color, the composition of completing light ink previously cannot appear easily from the composition which records dark ink previously. This can be said since there are few differences of the coloring nature by the order of ink placing in light ink than that in dark ink. Furthermore, since each dot spreads uniformly greatly, a picture smooth on the whole can be acquired. therefore, also in this example, the direction of a recording head with the array which records light ink previously is alike, receives a color image picture, and it can call it the composition to

which it was more suitable

[0211] On the other hand, since it is not obscured in the light ink in which dark ink is recorded after that although surely an irregular color tends to be conspicuous when dark ink is recorded previously, the concentration and resolution of each pixel itself are high, and the picture of high resolving carried out distinctly is acquired. Therefore, the head which records dark ink previously can call it the composition for which it was suitable with the black character picture with high concentration etc.

[0212] In this example, although two kinds of concentration ink, dark ink and light ink, has explained each color, in order to make a picture good further, it is still better as for three or more kinds in the level of concentration. In this case, what is necessary is just to make the delivery train of the ink in which concentration differs arrange in the direction of an ejection, as shown in drawing 35.

[0213] In a color ink-jet recording device with the recording head which carries out the regurgitation of the shade ink according to [as explained above] this example, by arranging each color ink in the direction of a head writing scan, and making a shade ink delivery arrange in the direction of an ejection, the irregular color and shade unevenness which originate in order of ink placing in the case of both-directions record can be abolished, and a good picture can be acquired.

[0214] ** is just explained to the modification 1 of an example 2, next the modification of the above-mentioned example 2. It is head composition, i.e., delivery array composition, about shade unevenness, and to having solved the irregular color by the division recording method, by this example, the above-mentioned example 2 is the division recording method about shade unevenness, and cancels an irregular color with head composition.

[0215] The recording head composition of this modification is shown in drawing 36. Although the recording head which arranges 16 deliveries in one train is used like [this modification] the above-mentioned example 2, a dark ink head and a light ink head are made to become independent here, and it is made to stand in a row in the direction of a writing scan. Each delivery train is making it arrange four deliveries of each color at a time toward the direction of an ejection.

[0216] Although the color order of record is made into black, cyanogen, a Magenta, and yellow in this example, the order of an array of the direction of an ejection is not restricted to one kind like an example 2. Moreover, in this example, since only four deliveries have the delivery with them per each color and each concentration, in order to perform division record, the amount of ejections for every writing scan serves as 2-pixel width of face.

[0217] Drawing 37 shows the record state when recording by this example. The case where a uniform green picture is recorded with cyanogen and yellow is taken for the example like the example 2 also here.

[0218] In the start of record, although the nose of cam of a form is set as a black delivery position when black data exist, since it is not necessary to record black ink, by the green picture explained by this example, a record form is moved to the delivery position of cyanogen, as shown in this drawing. Although four deliveries of cyanogen deliveries exist in all at this time, in order to perform division record, by the 1st writing scan, a record form is set as the position of two deliveries in the lower half of a cyano delivery.

[0219] Since the 1st writing scan is outward trip record, to a record pixel, it reaches the target in order of the cyanogen of dark ink, and the cyanogen of light ink. Since dark ink reaches the target previously, in the pixel recorded here, it becomes the form where a big cyano dot with thin concentration surrounds thinly the surroundings of the cyanogen in which concentration is high and the dot profile clarified. Then, the ejection of 2-pixel width of face is performed, and it continues to the 2nd following writing scan. In addition, the pixel array simultaneously recorded by each writing scan by this example as well as the above-mentioned example 2 uses that to which the pixel group of 1x2 became alternate.

[0220] The 2nd writing scan is a return trip scan, and ink reaches the target to each pixel in order of the cyanogen of light ink, and the cyanogen of dark ink. The dot of the dark ink recorded after light ink already reaches the target sinks into the surroundings of the dot of light ink

greatly, and becomes what has concentration lower than the dot obtained by outward trip scan uniform. In the 1st picture field which record of cyanogen completes by 2 times of the writing scans so far, a cyano dot with high concentration and the low cyanogen dot of concentration will be intermingled an abbreviation moiety every. Moreover, in the 2nd picture field following this 1st picture field, the half of a cyano dot is recorded by the return trip record at this time.

[0221] In the 3rd and 4th following writing scans, since the 1st picture field is located corresponding to the Magenta delivery section, actual record is not performed. However, record of a cyanogen dot is made one by one in each picture field located in the cyano delivery section below in the 2nd picture field following this.

[0222] That the 1st picture field where record of a cyano dot was made is recorded on a degree is the 5th writing scan in which this field is located corresponding to the yellow delivery section. Yellow ink reaches the target in order of the upper shell and dark ink in which cyano ink is already recorded, and light ink. Since cyano ink will already be absorbed and it will be recorded above although a record pixel turns into a yellow pixel with high concentration if ink is struck by this turn on a blank paper, yellow ink is large to the surroundings of cyano ink, or the down side, and neither a wraparound, a dot configuration nor the difference in a shade appears here.

[0223] When repeating the writing scan both ways successively as mentioned above, when located in the cyano delivery section, and only when it is located in the yellow delivery section after 2 scans, record has accomplished in each picture field. Here, since yellow is recorded after record of cyanogen is completed in all picture fields, the irregular color evil at the time of the both-way record explained in the conventional example is solved by the recording head composition of this example.

[0224] In the color ink-jet recording device which had a shade ink head according to [as explained above] this modification, by arranging the delivery of shade ink in the direction of a writing scan, and making each color ink delivery arrange in the direction of an ejection, the irregular color and shade unevenness which originate in order of ink placing in the case of both-directions record can be abolished, and a good picture can be acquired.

[0225] In addition, in this example, the turn of the ink color arranged in the direction of an ejection is not what was restricted to one kind. Any arrays can acquire the same effect in this invention. Having brought black ink to the head especially by this example means to make the concentration and resolution of black ink the highest in four colors, and that the concentration of black ink and resolution are high leads to acquiring a clear black character picture.

[0226] The modification 2 of an example 2, next other modifications of an example 2 are explained.

[0227] One head was made to correspond at a time with a color or concentration in the example 2 mentioned above and its modification 1 using two or more recording heads, respectively. On the other hand, the number of the recording heads used for this example is one. That is, as shown in the example 1 grade, the ink delivery corresponding to all concentration and colors is constituted in ******, and these are beforehand constituted in this recording head at one.

[0228] Drawing 38 is the ** type view showing the composition of the recording head used for this example.

[0229] It has eight deliveries of eight pieces and light ink for the delivery of dark ink about each color ink, respectively, and record of one color is completed by a total of 16 deliveries. Although the delivery group of each color is arranged in the direction of an ejection in order of black (K), cyanogen (C), a Magenta (M), and yellow (Y), the delivery groups of ***** each color overlap by one delivery mutually at this time.

[0230] In drawing 38 , the horizontal line shown as the solid line on the head is also what showed the ejection state, and the head pixel of the recording paper is the ejection scan of 4-pixel width of face, and showed one by one which ***** it was. When delivery array composition like this example is taken so that it may see to this drawing, this head pixel will be located in a different portion for every color of each eight deliveries which carry out a color array. That is, although this head pixel may serve as the bond section of division record in black, the bond section does not become in cyanogen, a Magenta, and yellow.

[0231] The record state by the example shown in drawing 39 is shown as a state which records

a uniform green picture like each above-mentioned example. Since it is the same as that of the above-mentioned modification 1 that the ink delivery of a different color has also arranged this example in the direction of an ejection, in both-way record of each writing scan, only cyanogen or the picture field which came to the delivery position of yellow will be recorded. The picture field said here points out the thing of the field of the 4-pixel width of face which each color recording head records simultaneously, namely, it ties with the bond section of each color, and the thing of the field between the sections is said. therefore, the picture field of an example old in this example — differing — each color — respectively — mutual — the picture field will be constituted

[0232] Drawing 40 shows the bond section (picture field) of the record picture after the 6th writing scan in drawing 39, and each color. Here, it is shown that each bond section (picture field) has appeared in the position where 1 pixel of each color shifted at a time, respectively. Thus, the book stated in the above-mentioned example 2 and the modification 1 so far by making it appear in a position which tied for every color and is different in the section

[0233] By the way, although it constituted from this example so that the delivery position in a recording head might be piled up each color of one every delivery in order to tie for every color and to change a position, the delivery array composition for changing a bond position is not what was restricted to this array. For example, even if it detaches 1-pixel at a time conversely and makes each color arrange, the same effect is acquired and can exclude completely the element of the irregular color by both-directions record in this case.

[0234] Moreover, in order to make the partition portion between each common liquid room in a recording head into a positive thing, it is desirable also in a recording head creation process to keep a certain amount of distance and to arrange a delivery train.

[0235] Furthermore, if the increase of the number of the deliveries which participate in record, and the amount of ejections also become large, the bond section of each color can be appeared in various positions.

[0236] Furthermore, the turn of the ink color arranged in the direction of an ejection like the above-mentioned modification 1 also in this example is not what was restricted to one kind. An effect with any same arrays can be acquired.

[0237] In the example 2 and modifications 1 and 2 which were explained above, although the image formation by 2 division records was altogether explained for the example, the division record with more much number of partitions is also possible as a means for making the effect of this invention still more effective. The absolute magnitude of make [the record number of partitions / many] of the ink which will apply much more deliveries to one picture field, and is driven in in this picture field by 1 time of the writing scan also decreases. Therefore, while a picture can be smoothed more, the effect of the irregular color depended for oozing out and shade unevenness HE which have so far been explained is also expectable.

[0238] Drawing 41 is drawing for ink suction operation of the ink-jet recording device which applied this invention being shown, and is the cross section showing typically the cap portion shown in drawing 18.

[0239] In drawing 41, the porous ink absorber 20 is formed in the interior of each capping 17. As shown in drawing 41 (A), this ink absorber 20 is arranged so that it may be located near the delivery forming face 21 at the time of capping. In addition, the high-density slash portion 30 in drawing 41 shows the ink (drawn in) sucked out of the delivery.

[0240] Drawing 41 (A) sticks a cap 117 to the delivery side 21, operates a suction pump, and after it attracts ink from each delivery by generating negative pressure in a cap 17 through a tube 27, it shows the state when stopping operation of a suction pump. In this state, the negative pressure in a suction pump is almost canceled by attracting the ink of a certain amount. That is, negative pressure is decreasing to the grade which the meniscus of each delivery does not make destroy. If a cap 117 is pulled apart from the delivery side 21 while negative pressure has been in a strong state, atmospheric pressure takes in an instant in a cap 15, the meniscus in a delivery is torn by this rapid pressure fluctuation, air enters in a delivery, and the poor regurgitation may be started.

[0241] Moreover, as shown in drawing 43, the force which makes ink the method of sucking with

the adhesion force of ink or the negative pressure in a delivery in the interface of a delivery forming face and ink acts. In order that the surface tension which ink itself tends to condense may furthermore act on the ink in a cap 103, As it is narrow between ink 104, 105 arises and a cap separates the cross section of each vena-contracta 105 portion of ink 104 — small — becoming — there — most — weak — becoming — just — being alike — the relation between ink goes out in the portion of each vena contracta 105, and an ink drop may remain on a delivery forming face

[0242] In the state of drawing 41 (A), most inside of a cap 117 is full of ink, and is in the state where the ink absorber 20 is also saturated and there is almost no absorptance. If a cap is pulled apart in the state with this, a case of drawing 43 mentioned above and a result by which a lot of ink remains in the delivery forming face 21 similarly will be brought. Then, in this example, a crevice 31 is produced between a cap 117 and a delivery by carrying out very small movement of the carriage rightward in drawing. The very small movement magnitude of the carriage at this time is set as the suitable amount beyond the range in which sealing with a cap 117 is possible.

[0243] Drawing 42 is the ** type view showing the state of the above-mentioned very small movement of carriage, drawing 42 (A) shows the state before movement, and drawing 42 (B) shows the state after movement. Moreover, drawing 41 (B) shows the state inside the cap immediately after carrying out the above-mentioned very small movement of the carriage from the state of drawing 41 (A). As shown in drawing 41 (B) and drawing 42 (B), a suction pump is operated again in the place which produced the crevice 31. The state inside the cap at this time is shown in drawing 41 (C). That is, if it changes into the state of drawing 41 (B) and a suction pump is operated again, since the cap is in the leak (opening) state, as shown in drawing 41 (C), only the ink in a cap 15 is attracted through a tube 27, and the ink absorber 20 of the porosity established in the cap 117 is recovered in the state in which ink absorption is possible again. Moreover, in the state of drawing 41 (C), since the porous ink absorber 20 is close to the delivery side 21, almost all the ink on the delivery forming face 21 is absorbed by the ink absorber 20. In this way, the ink absorbed by the ink absorber 20 is also attracted through a tube 27.

[0244] And at this time, carriage is returned to the position of the original position (A), i.e., drawing 41, and drawing 42 (A) once again, and ink absorptivity ability is changed into the state where the fully recovered ink absorber 20 approaches to all the fields of the delivery forming face 21. By carrying out like this, the ink remainder on the delivery forming face 21 can be decreased further.

[0245] Since the ink remainder on a delivery forming face decreases, color mixture generating can be prevented by recovery action.

[0246] Since a crevice 31 was produced, although carriage was moved to main scanning direction in the above-mentioned example, you may make it move in the direction of vertical scanning. furthermore, not carriage but a cap side is moved aslant etc. the upper and lower sides, right and left, and approximately — you may constitute

[0247] By the above, the ink remainder on a delivery forming face can be lost, without preparing an air open valve.

[0248] Drawing 44 is the typical cross section of the cap portion for other examples of suction operation being shown.

[0249] In drawing 44, the porous ink absorber 52 is formed in the interior of each cap 117. The capacity of this ink absorber 52 is set as the larger value than the amount of suction of a suction pump (the amount of forced discharges of the ink by 1 operation), or the larger value than the content volume of the ink passage of an ink-jet unit. And as shown in drawing 44 (A), the above-mentioned ink absorber 52 is arranged so that it may be located near the delivery forming face 81 at the time of capping. In addition, the slash portion 53 in drawing 44 shows the ink (drawn in) sucked out of the delivery.

[0250] Drawing 44 (A) sticks a cap 117 to the delivery forming face 81, operates a suction pump, and shows the state where ink 52 is attracted from each delivery, by generating negative pressure in a cap 117 through a tube 19. Then, to predetermined timing, as shown in drawing 44 (B), a recording head and a cap 117 are separated and a crevice 54 is formed between them.

Even if it is in the time of the negative pressure in a suction pump almost being canceled by stopping operation of a suction pump and attracting the ink of the specified quantity as timing which separates this recording head and cap 117, or the state where negative pressure is acting in a cap 117, the time of attracting the ink of the specified quantity etc. is selected. In addition, the ink attracted by the suction pump from a recording head is sent out through a tube or ink passage to a non-illustrated waste ink tank. This waste ink tank may constitute waste ink from an ink absorber of the porosity which carries out absorption maintenance.

[0251] In drawing 44, the capacity of the porous ink absorber 52 is set as the larger value than the amount of suction of a suction pump (the amount of forced discharges of the ink by 1 operation), or the larger value than the content volume of the ink passage of a recording head like the above-mentioned. Therefore, it has to this ink absorber 52 side with the suction force of the ink absorber 52, and the ink 53 between the delivery forming face 81 and a cap 117 goes, as shown in drawing 44 (C). Consequently, as shown in drawing 44 (D), suction recovery action can be ended in the state where it does not leave ink to the delivery forming face 81 of a recording head. In this way, since suction recovery action is completed in the state where ink does not remain in the delivery forming face 81, the color mixture of unique ink can be prevented.

[0252] Moreover, by being filled up with the porous ink absorber 52 in a cap, directivity (direction which goes to a suction pump side from the delivery side 81) can be given to the ink flow in the cap 117 at the time of suction, and it enables the unique ink adhering to the delivery forming face 81 to prevent the color mixture of invading in a delivery.

[0253] (in addition to this) In addition, especially this invention is equipped with meanses (for example, an electric thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used also in an ink-jet recording method in order to make the ink regurgitation perform, and brings about the effect which was excellent in the recording head of the method which makes the change of state of ink occur with the aforementioned heat energy, and the recording device. It is because the densification of record and highly minute-ization can be attained according to this method.

[0254] About the typical composition and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 specification and the 4740796 specification, for example is desirable. Although this method is applicable to both the so-called on-demand type and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the on-demand type case By impressing at least one driving signal which gives the rapid temperature rise which corresponds to recording information and exceeds nucleate boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the foam in the liquid (ink) corresponding to this driving signal can be formed by the one to one as a result, it is effective. A liquid (ink) is made to breathe out through opening for regurgitation by growth of this foam, and contraction, and at least one drop is formed. If this driving signal is made into the shape of a pulse form, since growth contraction of a foam will be performed appropriately instancy, the regurgitation of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable. As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed.

[0255] The composition using the U.S. Pat. No. 4558333 specification and U.S. Pat. No. 4459600 specification which indicate the composition arranged to a delivery which is indicated by each above-mentioned specification as composition of a recording head, the liquid route, and the field to which the heat operation section other than the combination composition (a straight-line-like liquid flow channel or right-angled liquid flow channel) of an electric thermal-conversion object is crooked is also included in this invention. In addition, the effect of this invention is effective also as composition based on JP,59-138461,A which indicates the composition whose puncturing which absorbs the pressure wave of JP,59-123670,A which indicates the composition which

makes a common slit the regurgitation section of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to the regurgitation section. That is, it is because it can record efficiently certainly according to this invention no matter the gestalt of a recording head may be what thing.

[0256] In addition, this invention is effective when the thing of a serial type like an upper example also uses the recording head fixed to the main part of equipment, the recording head exchangeable chip type to which the electric connection with the main part of equipment and supply of the ink from the main part of equipment are attained by the main part of equipment being equipped, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one.

[0257] Moreover, it is a book as composition of the recording device of this invention to add the regurgitation recovery means of a recording head, preliminary auxiliary means, etc. If these are mentioned concretely, a preheating means to heat using the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head, and a reserve regurgitation means to perform the regurgitation different from record can be mentioned.

[0258] moreover, two or more ink which differs in an others and record color or concentration although only one piece was prepared also about the kind or the number of a recording head carried, for example corresponding to monochromatic ink — corresponding — two or more pieces — more than — it may be prepared That is, although not only the recording mode of only mainstream colors, such as black, but a recording head may be constituted in one as a recording mode of a recording device or the paddle gap by two or more combination is sufficient, for example, this invention is very effective also in equipment equipped with at least one of each of the full color recording mode by the double color color of a different color, or color mixture.

[0259] Furthermore, in addition, in this invention example explained above, although ink is explained as a liquid It is ink solidified less than [a room temperature or it], and what is softened or liquefied at a room temperature may be used. Or by the ink-jet method, since what carries out a temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stable regurgitation range about the viscosity of ink, ink may use what makes the shape of liquid at the time of use record signal grant. In addition, in order to prevent the temperature up by heat energy positively because you make it use it as energy of the change of state from a solid state to the liquid state of ink, or in order to prevent evaporation of ink, you may use the ink which solidifies in the state of neglect and is liquefied by heating. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied when using the ink of the property liquefied for the first time by grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when reaching a record medium. The ink in such a case is good for a porosity sheet crevice or a breakthrough which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the state where it was held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0260] Furthermore, in addition, as a form of this invention ink-jet recording device, although used as the picture outgoing end end of information management systems, such as a computer, you may take the form of the reproducing unit combined with others, the reader, etc., and the facsimile apparatus which has a transceiver function further.

[0261]

[Effect of the Invention] Since two or more delivery trains which carry out the regurgitation of the ink in which kinds, such as concentration and a color, differ, respectively can be divided and established in the different direction from the move direction of the recording head at one according to this invention so that clearly from the above explanation, the miniaturization of the recording head itself and the mechanism for moving this is attained.

[0262] Moreover, a field recordable by one movement is divided, and when dividing and recording the pixel of the division field of a parenthesis by movement of multiple times, sequence that the

ink in which two or more above-mentioned kinds of recording head differ laps by arrangement of two or more above-mentioned delivery trains in a recording head can always be made equal. [0263] Consequently, while the miniaturization of equipment etc. is attained, reduction **** of the irregular color in the case of color record or shade unevenness can record a picture.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] Especially this invention relates to the ink-jet recording head and ink-jet recording device for recording a picture using the ink in which concentration differs about an affiliated color about record of an ink-jet recording head and an ink-jet recording device.

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PRIOR ART

[Description of the Prior Art] What performs digital image record using the recording head by the ink-jet method as one of the image formation equipment (henceforth a recording device) as information management systems, such as a reproducing unit, and a word processor, a computer, and an information [in / those devices / further in connection with the spread of communication equipment] output means has spread quickly. In such a recording device, what used the so-called multi-nozzle head which accumulated two or more liquid routes which are open for free passage to an ink delivery and this as a record element is common because of improvement in recording rate.

[0003] Many diameter control systems of a dot which control the size of the dot density control system which controls the number of record dots per unit area by the record dot of fixed size, and expresses halftone as a method, or a record dot which expresses halftone in the recording device of this method, and express halftone are used.

[0004] Since the latter diameter control system of a dot has the restrictions with the complicated control needed generally for changing the size of a record dot delicately here, When an electric thermal-conversion element is used as an energy generation means to generate the energy with which it is rare to be used and is especially used for the ink regurgitation, the recording head using this element manufacture is comparatively easy, and since a delivery etc. can be allotted with high density, record of high resolution is possible — etc., although it has an advantage It is difficult to change the pressure exerted on ink in the case of the regurgitation, therefore since it is difficult to modulate the path of a record dot, it is rare to use the diameter control system of a dot. When the recording head of an ink-jet method is used from the above reason, it uses for a dot density control system in many cases.

[0005] On the other hand, as one of the typical things of the binary-ized technique of halftone expression used for the dot density controlling method, although there is a systematic dither method, this method has the problem that the number of gradation is restricted by the size of a dither matrix. That is, although it is necessary to enlarge matrix size in order to make [many] the number of gradation, when matrix size is enlarged, 1 pixel becomes large [the record picture which consists of one matrix], and there are problems, such as spoiling resolution.

[0006] On the other hand, there are conditional determination type dither methods, such as an error diffusion method, as another typical thing of the binary-ized technique. This is the method of changing a threshold in consideration of the circumference pixel of an input pixel to being the independent determination type dither method which the systematic dither method mentioned above makes binary using a threshold unrelated to an input pixel. The conditional determination type dither method represented by this error diffusion method has gradation nature and the good compatibility of resolution, and when a subject-copy image is a printing picture, the advantages, like it is very rare to generate a moire pattern are in a record picture.

[0007] On the other hand, graininess tends to be conspicuous by the bright section of a record picture, and there is a problem that quality of image deteriorates, and this problem becomes remarkable in the low record picture of recording density especially.

[0008] Two or more recording heads which carry out the regurgitation of the ink in which concentration differs about the ink of the same color conventionally as what solves the problem

of the above graininess, respectively are prepared, a halftone portion forms a record dot in the low ink (light ink) of concentration from the bright section of a picture, and the record method that dark space forms a record dot in ink with high concentration (dark ink) from a halftone portion is proposed.

[0009] Drawing 1 is the perspective diagram showing the important section of the color ink-jet recording device of the conventional example by the serial print method using the shade ink concerning the above-mentioned record method.

[0010] Keep predetermined distance from carriage 241 respectively, and arrange a recording head [carrying out the regurgitation of the light ink of recording head / carrying out the regurgitation of the dark ink of recording head / carrying out the regurgitation of the light ink of recording head / carrying out the regurgitation of the dark ink of recording head / carrying out the regurgitation of the light ink of recording head / carrying out the regurgitation of the dark ink of recording head Ku, and cyanogen / Ck, and cyanogen / Cu, and a Magenta / Mk, and a Magenta / Mu, and yellow / Yk Carriage 241 is made to carry out both-way movement along with the above-mentioned guide shaft 243 by the drive of the carriage motor 245 which guidance support of the sliding of was enabled by the guide shaft 243, and minded the driving belt 244.

[0011] the liquid route which is open for free passage to the ink delivery of each recording head --- the ink regurgitation --- business --- **** --- heat energy --- it is prepared in the heater element (electric thermal-conversion element) to generate

[0012] The ink used by each recording head is stored by the ink cartridge 248 prepared corresponding to each color, and is supplied through each ink supply path. Moreover, a transfer of the control signal from the device control section to a recording head or a driving signal is performed through the flexible cable 249.

[0013] With the conveyance roller (un-illustrating) and the delivery roller 242 which make a non-illustrated conveyance motor a driving source, the recorded material which consists of a record form, plastics sheet metal, etc. is conveyed in the direction of the arrow in drawing, and record is made and it goes to the field which counters with movement of each recording head in the meantime. That is, according to the reading timing of an encoder (un-illustrating) which detects the move position of carriage 241, the above-mentioned heater element is driven based on a record signal, and a picture can be recorded for an ink drop by the regurgitation and making it adhere on a recorded material in order of ** of black, **, ** of cyanogen, **, ** of a Magenta, **, ** of yellow, and **.

[0014] The recovery unit 246 with the cap section 247 is arranged in the home position set up outside the record section by movement of carriage 241, and the ink regurgitation property of each recording head is stabilized by the regurgitation recovery by this recovery unit.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since the delivery train of ***** which breathes out the ink in which kinds, such as concentration and a color, differ, respectively can be divided and established in the different direction from the move direction of the recording head at one according to this invention so that clearly from the above explanation, the miniaturization of the recording head itself and the mechanism for moving this is attained.

[0262] Moreover, a field recordable by one movement is divided, and when dividing and recording the pixel of the division field of a parenthesis by movement of multiple times, sequence that the ink in which two or more above-mentioned kinds of recording head differ laps by arrangement of two or more above-mentioned delivery trains in a recording head can always be made equal.

[0263] Consequently, while the miniaturization of equipment etc. is attained, reduction **** of the irregular color in the case of color record or shade unevenness can record a picture.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] as [show / below / although the ink-jet recording device using the conventional shade ink explained above solves the problem of the graininess in a record picture comparatively well and is one of the effective technique for the improvement in quality of image / recording device] — it divides roughly and there are two troubles

[0016] 1) Since the ink-jet recording device using conventional shade ink had prepared the recording head and the ink cartridge for every ink to be used, the problem that the increase of the number of recording heads and the number of ink cartridges and a recording device are enlarged is in the 1st.

[0017] Moreover, the weight of a recording head and carriage will also increase, the distance of the lamp up and down at the time of carriage movement becomes long, and equipment is enlarged similarly. Moreover, in order to make carriage drive by the above-mentioned weight increase, a load increases, the need of using the big drive motor of torque, and the need for the complicated mechanism for the capping performance maintenance of a cap prepared according to the number of recording heads are produced, and there is a problem that the cost for it increases. [much]

[0018] Furthermore, since the number of recording heads increased, registration of each color recording head needed to be performed with a more sufficient precision, the expensive parts which made part precision high for the reason needed to be used, and complicated alignment adjustment and amendment control needed to be performed.

[0019] In addition, when recording using shade ink, and the difference of the dot concentration between shade ink is large, reappearance of gradation does not become alignment in the switch portions of light ink and dark ink in a record picture, but it is easy to produce a false profile. Moreover, there was also a problem from which change of the graininess of a picture and change of a color tone which were recorded occur in the above-mentioned ink switch portion, and serve as an unnatural picture. Although there is the method of recording by using low concentration ink, inside concentration ink, and high concentration ink etc. increasing the stage of concentration in order to solve such a problem, it is clear to promote the problem about above-mentioned size more.

[0020] 2) When using the ink in which concentration differs about each ink of two or more colors in the case of performing color record to the 2nd, there is a problem that the unevenness in the record picture which originated in each in order of the lap of the ink in which concentration differs in the sequence and the same color of a lap of each color ink etc. is easily uncancelable.

[0021] It is known that canceling concentration unevenness and the same thing can be used as the conventional technique of canceling the above-mentioned unevenness etc. This is explained below.

[0022] For example, in a color printer, various conditions, such as coloring nature, gradation nature, and uniformity, are needed in recording an image picture unlike what records only characters, such as a character printer. Especially slight dispersion for every delivery produced at the manufacture process of a multi-nozzle head about uniformity affects the discharge quantity of the ink of each delivery in the case of record, and the sense of a discharge direction, and becomes the cause of degrading picture grace as concentration unevenness of a record

picture as a result.

[0023] The example is explained using drawing 2 and drawing 3.

[0024] In drawing 2 (A), 91 is the so-called multi-nozzle head, and since it is easy, it shall be constituted by eight deliveries 92 which carry out the regurgitation only of one kind of ink of monochrome and single concentration. 93 is the ink drops let breathed out from each delivery 92, as shown in this drawing, the ink drops let 93 is the same discharge quantity, and it is an ideal to be breathed out in the same direction. And if such regurgitation is performed, as shown in drawing 2 (B), the dot of a size equal on space will be recorded and the uniform picture which does not have concentration unevenness on the whole will be acquired (refer to drawing 2 (C)).

[0025] However, as stated also in advance in fact, there is many dispersion for every delivery, respectively, as shown in drawing 3 (A), dispersion arises in the amount and direction of ink drops which are breathed out from each delivery, and the size of a record dot and dispersion of an impact position as shown in drawing 3 (B) arise. Consequently, the portion of the blank paper which cannot fill area factor 100% along with the main scanning direction of a recording head exists, a dot overlaps reverse more than required, or a white muscle which is seen in the center of this drawing 3 (B) occurs. In this case, a concentration distribution becomes what is shown in drawing 3 (C), as a result, is the limitation usually seen by human being's eyes, and is sensed as concentration unevenness.

[0026] Moreover, when the amount of the ejection repeated for 1 time of every writing scan is not controlled uniformly, the same concentration unevenness etc. is produced. For example, when more ejections than a constant rate are made, it will be recorded on the position which the dot and dot of an edge of each scanning field separated from the amount of conventions, and the portion will be conspicuous as a white stripe. On the contrary, when an ejection is made fewer than a constant rate, the dots and dots of an edge will overlap more than required, and will be conspicuous as a black stripe. The more pixel density becomes high, when strict control is required and this is not filled the more, the value of this amount of ejections will be connected on a record picture, and a stripe will generate it.

[0027] The following methods are proposed in order to prevent generating of the above concentration unevenness or a stripe.

[0028] Drawing 4 and drawing 5 explain the method. Although it is necessary to make a recording head 91 scan 3 times although the record section shown by drawing 2 and drawing 3 is completed, as shown in these views according to this method, the field equivalent to the half of the field, i.e., the half of the delivery array of a recording head, is completed by two scans. That is, after recording [by dividing eight deliveries of a recording head into two groups of upper 4 deliveries and lower 4 deliveries] the dot of four pixel trains using lower 4 deliveries, respectively by the 1st scan and carrying out the ejection for four deliveries in this case, in the 2nd scan, a dot is recorded on the portion on which the dot of the four above-mentioned pixel trains is not recorded using upper 4 deliveries. At this time, by each two scan, the dot which should be recorded by two scans is thinned out by the abbreviation half, and the dot recorded by each scan has a complementary relation. Below, such a recording method is called the division recording method.

[0029] Since the influence on the record picture for every delivery will be reduced by half even if it uses the recording head which has dispersion in a regurgitation property for every delivery as shown by drawing 3 if such a division recording method is performed, the recorded picture comes to be shown in drawing 4 (B), and a black stripe and a white stripe which are seen to drawing 3 (B) stop being so much conspicuous. Therefore, as concentration unevenness is also shown in drawing 4 (C), as compared with the case of drawing 3 (C), it is eased considerably. Moreover, if this division recording method is performed, since the dot of 1 pixel train will be recorded by the delivery of a recording head edge, and the delivery of a recording head center section, the bond stripe produced on the boundary of each scanning field can also be reduced by half.

[0030] Although it divides by 1 scan eye and 2 scan eye so that it may compensate for image data mutually according to the regular array with a dot (complementary) in case such record is performed, as shown in drawing 5, as for this image data division (henceforth an infanticide

pattern), it is usually most common that a dot uses what becomes a hound's-tooth check exactly for 1 pixel of every direction. Therefore, record is completed by 1 scan eye which records a hound's-tooth check in a unit record section (here 4-pixel unit), and 2 scan eye which records a reverse hound's-tooth check.

[0031] It explains how record of a fixed field is completed and drawing 5 (A), (B), and (C) go, when alternate [this] and a reverse alternate pattern are used, respectively. By 1 scan eye, the dot 51 which forms an alternate pattern using lower 4 nozzles is recorded first (drawing 5 (A)). Next, after performing an ejection by 4 pixels (1/2 of head length), the dot 52 of a reverse alternate pattern is recorded by 2 scan eye (drawing 5 (B)). After performing a 4 pixels (1/2 of head length) ejection again, the dot 53 of an alternate pattern is again recorded on eye further 3 scans (drawing 5 (C)). Thus, the record section of a 4-pixel unit is completed for every scan by performing record of the ejection of a 4-pixel unit, and a 1000 birds and a reverse alternate pattern by turns one by one. As explained above, when recorded by two kinds of deliveries from which the dot of the same pixel train differs, it becomes possible to equalize the influence of dispersion in the regurgitation property for every delivery, and to acquire a high definition picture with little concentration unevenness.

[0032] Such a record method is already indicated by for example, JP,60-107975,A and a USP No. 4967203 official report, and the effective thing is stated to each to the concentration unevenness fellow calm stripe. It is indicated in the former, saying "It is characterized by having a means to make the ejection of each horizontal scanning fewer than the width of face of this horizontal scanning, to overlap two adjoining horizontal scanning, and to form a duplication portion, and a means to arrange the printing dot of this duplication portion so that it may not lap in two horizontal scanning." In this official report, although [an infanticide mask] it "1 Is **** alternately about odd level and even level every train", it may record at random by the case where even level is ****(ed) by odd level and the 2nd scan by the 1st horizontal scanning, and each scan, and an infanticide mask and ejection width of face are not limited completely.

[0033] On the other hand, it sets in the latter USP No. 4967203 official report. "The pixel which printed the police box pixel position where only the upper half in the 1st band does not adjoin a level perpendicular direction with the a 1st path, and was not printed with the 1st path in the 1st band with the b 2nd path, The 1st path is performed on the band which continues immediately after at the same time it prints on the police box-pixel which does not adjoin the level perpendicular direction of the lower half in the 1st band and prints the pixel in the 1st and 1st band which were not printed with the 2nd path with the c 3rd path."

It is indicated. Thus, in this official report, the police box pixel array which does not adjoin a perpendicular horizontal direction as an infanticide mask which performs division record is limited.

[0034] As composition further added in this official report, several pixels are summarized for gradation expression or multicolor expression, a false pixel (super pixel) is formed, and the recording method for performing the police box infanticide print which does not adjoin a level perpendicular direction per false pixel (super pixel) is indicated. And once it incorporates the system for realizing the "above-mentioned method according to this method in which of program software or printer form wear the quality of this print is attained, without complicating recklessly the work which creates the computer program for making much colors, since a program can be called by the color number of the combination specified about the super pixel It is described as " and the simplification of programming for multicolor expression is also raised as an effect. Moreover, since it has the intention of each super pixel being perceived as single homogeneous color, it is said that bleeding of the color within a super pixel is harmless.

[0035] By the way, in order to raise recording rate in the conventional printer of composition of putting the recording head of two or more colors in order in the direction of a writing scan, when performing both-directions record and not using the above-mentioned division recording method, an irregular color etc. may be generated simultaneously with generating of the unevenness mentioned above. Hereafter, the reason is explained.

[0036] The impact state to the record medium-ed of the record ink currently used for general present (paper) is shown in the cross section of drawing 6 . Here, the case where the position

which set time difference and almost adjoined is made to absorb the ink (dot) of two different colors (record) is shown. Notes are that the direction of the dot struck after the dot recorded previously is in the inclination which sinks in the depth direction of space in a 2-dot lap portion. This is the stage combined as physically [coloring matter, such as a color in the breathed-out ink,] as a record medium-ed, and chemically. In the limitation which does not have a big difference in bonding strength by the kind of coloring matter since combination of a record medium-ed and coloring matter is limited It is because it is thought that the coloring matter remains to a recorded intermediation body surface mostly, and it is hard to combine the coloring matter of the ink struck later in a recorded intermediation body surface, and it sinks in the space depth direction and combines with it since priority is given to combination with the coloring matter of ink and the record medium-ed which were breathed out previously.

[0037] In this case, since a priority color will change with placing sequence of two kinds of ink similarly when two kinds of ink is recorded on this impact area, two colors which change with placing sequence will be expressed to human being's visual-sense property as a result. For example, when a green (cyanogen + yellow) picture is formed in a certain fixed field and ink is driven into each pixel in order of cyanogen and yellow, the cyanogen absorbed previously serves as a priority color, and serves as a strong green picture of coloring of cyanogen. On the contrary, when ink is driven in in order of yellow and cyanogen, the strong green picture of coloring of yellow will be acquired.

[0038] Here, since considering the case where both-directions record is performed the recording head of each color is arranged in the direction of a writing scan as shown, for example in drawing 1, the order of placing of the ink recorded on an outward trip and the order of placing of the ink recorded in a return trip are reversed. Therefore, coloring of the dot recorded on an outward trip and coloring of the dot recorded in a return trip become a different thing. When the ejection for length of one delivery array for every writing scan usually performed is performed, it appears by turns for every scan line, and two kinds of different color tones and different concentration serve as a big irregular color, and make quality of image deteriorate by the whole record picture in such the state.

[0039] However, it is conquerable by using the division recording method for having also mentioned such evil above. Namely, coloring of the dot recorded on an outward trip (drawing 5 (A), (C)) as drawing 5 explained by performing division record, Since coloring of the dot recorded in a return trip (drawing 5 (B)) can make it mostly intermingled a moiety every in a fixed field, on the whole, the difference of the coloring nature of both dots is equalized, and middle coloring is obtained similarly exactly in every record section.

[0040] The above-mentioned composition and the above-mentioned effect about coloring nature are already indicated by for example, the USP No. 4748453 official report. By setting to the 1st complement-record to the pixel located in each record section by turns at a level perpendicular direction by the writing scan divided into the 2nd (or more than it), although there is no limitation of the amount of ejections here When forming the color picture at the time of preventing beading of the ink on record media-ed, such as a transparency film By reversing the order of ink placing of a color mixture pixel by the 1st scan and the 2nd scan has described the effect that (both-way record) and color banding (irregular color) can be prevented. Since the main purposes are prevention of beading between each pixel in this official report, the pixels recorded by one scan have been characterized by not adjoining mutually in a level perpendicular direction.

[0041] In JP,58-194541,A according to this application people on the other hand "Carry out the parallel arrangement of two or more record element arrays of a book, and a both-way run is made to carry out in the direction which goes to the aforementioned record element array direct. While recording intermittently the dot of the number fewer than all the dots in at least each line of a record dot matrix, and one side of each train that should be recorded in the outward trip of the aforementioned horizontal scanning in performing horizontal scanning of dot matrix record By recording intermittently the dot of the remainder in at least each aforementioned line and one side of each train in the return trip of the aforementioned horizontal scanning It is indicating with the record method characterized by changing mutually the sequence of duplication of the record in the duplicate-record dot by two or more aforementioned record element arrays in the outward

trip and return trip of the aforementioned horizontal scanning." There is no limit which makes the amount of ejections fewer than a part for the length of a record element array like the division record previously explained also in this official report, and it is considering the effect as prevention of picture degradation by color tone gap (irregular color) of the record picture based on the duplicate record (heavy record) of color ink. In this official report, since prevention of this color tone gap is the main purposes, there is no special limit of the dot position recorded by each scan, and the horizontal infanticide which is recorded only on lengthwise by turns in an example in addition to a checker (1000 birds, reverse 1000 birds), and the vertical infanticide repeated by turns only in a longitudinal direction are indicated.

[0042] Moreover, although not limited to a color printer, also in JP,55-113573,A, the composition which performs both-way record using an Aya ** (1000 bird, reverse 1000 birds) pattern is indicated. It aims at preventing that **** the dot which adjoins before it makes it there be no mark counterpart continuously and a **** dot gets dry the dot which adjoins in this official report by it, and dot distortion arises. Therefore, the infanticide mask as well as the above-mentioned USP No. 4748453 official report is limited the Aya ** here.

[0043] By the way, all of the official report of the three above-mentioned affairs aim at the irregular color at the time of both-way record, or prevention of beading. Therefore, the composition considering the concentration unevenness prevention resulting from dispersion in a delivery as one of the purposes of "making the amount of ejections during each scan below into the length of a delivery array" is not taken like the division recording method indicated by this application. Moreover, nothing is indicated also about the case where it records using two or more kinds of ink in which concentration differs.

[0044] Since the order of placing of an ink color can allot two kinds of reverse record pixels equally in a record section mutually if division record is performed in both-way record as explained above, the dissolution of an irregular color is also attained simultaneously with the concentration unevenness dissolution resulting from dispersion in a delivery.

[0045] However, the phenomenon in which a dot fixing state changes with order of ink placing can say the same thing, when driving in in piles the ink in which not only the irregular color mentioned above but concentration differs. That is, when the dot of ink with high concentration is recorded previously, the concentration of the dot of **** becomes preferential and the picture with high concentration carried out distinctly is acquired. On the other hand, when ink with high concentration is recorded after the low ink of concentration was struck, the ink sinks into the surroundings of the low ink of concentration greatly, and the smooth and uniform picture which concentration does not have is acquired.

[0046] If two or more ink in which concentration differs further about two or more sorts of each ink in consideration of the graininess in a record picture is used when performing color record using two or more sorts of ink as explained above, in addition to the irregular color resulting from the stacking-order foreword between [various] ink, the shade unevenness resulting from the stacking-order foreword between shade ink will also be produced, and how depending on which these irregular colors and shade unevenness appear will become more various.

[0047] Conventional recording head Kk-Yu used when performing the above color records in the ink-jet recording device shown in drawing 1, if it explains in more detail is an array as shown in drawing 7. For this reason, the combination of how depending on which ** which becomes possible, and various ink including ** lap will become more various by the scan at the time of performing color record as compared with the case where ** and light ink are not used.

[0048] For this reason, it may not be enough even if it is going to equalize an irregular color and shade unevenness by only using the above-mentioned division recording method as mentioned above. Moreover, it originates in the area in which the ink driven into each pixel so that it may be mentioned later spreads, and an irregular color etc. may be unable to be canceled.

[0049] this invention solves the 1st and 2nd problems produced when using ** and light ink which were mentioned above, and it is small and it aims at offering the ink-jet recording device by which the unevenness in the record picture was suppressed.

[Translation done.]

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MEANS

[Means for Solving the Problem] Therefore, it is the delivery train which comes to arrange ***** to which the aforementioned recording head breathes out ink in the ink-jet recording device which records on a record medium-ed by breathing out ink from the recording head concerned while moving this recording head to main scanning direction in this invention using the recording head of the ** sake which breathes out ink in the direction in which the aforementioned main scanning direction differs, and it is characterized by to have at one the delivery train of ***** which breathes out NKU of the kind from which each differs in the different direction from the aforementioned

[0051] Moreover, it sets using the recording head of the ** sake which breathes out ink to the ink-jet recording device which records on a record medium-ed by breathing out ink from the recording head concerned while moving this recording head to main scanning direction. The aforementioned recording head is a delivery train which comes to arrange ***** which breathes out ink in the direction in which the aforementioned main scanning direction differs. It has the delivery train of ***** which breathes out the ink of a kind in which each differs in the different direction from the aforementioned main scanning direction. The aforementioned recording head and the aforementioned record medium-ed in the different direction from the aforementioned main scanning direction It is characterized by what only width of face fewer than the width of face to which two or more aforementioned delivery trains extend performs relative displacement, records a part of pixel recordable by one movement of the aforementioned main scanning direction of the aforementioned recording head by one aforementioned movement for this movement of every, and records the remainder of the pixel in which the aforementioned record is possible for by other aforementioned one movement.

[0052] Furthermore, it is characterized by having at one the delivery train of ***** which breathes out the ink of a kind in which it is the delivery train which comes to arrange ***** which breathes out ink in the direction in which the move directions at the time of the use concerned differ, and each differs in the different direction from the aforementioned move direction.

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OPERATION

[Function] Since the delivery train of ***** which breathes out the ink in which kinds, such as concentration and a color, differ, respectively can be established in the different direction from the move direction of the recording head at one according to the above composition, the miniaturization of the recording head itself and the mechanism for moving this is attained.

[0054] Moreover, a field recordable by one movement is divided, and when dividing and recording the pixel of the division field of a parenthesis by movement of multiple times, sequence that the ink in which two or more above-mentioned kinds of recording head differ laps by arrangement of two or more above-mentioned delivery trains in a recording head can always be made equal.

[Translation done.]

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EXAMPLE

[Example] Hereafter, with reference to a drawing, the example of this invention is explained in detail.

[0056] Example 1 (recording device composition) drawing 8 is the block diagram showing the control composition of the color ink-jet recording device in one example of this invention.

[0057] It is reading optically about the manuscript picture according [on drawing and / a sign 1] to CCD etc. Or the picture input section which inputs a picture luminance signal (RGB) from a host computer, a video device, etc. is shown, and a sign 2 shows a control unit equipped with the various keys which direct a setup and recording start of various parameters. A sign 3 shows CPU which controls this whole recording device according to the various programs in the below-mentioned ROM. A sign 4 shows ROM which stores the program for operating this recording device according to a control program and an error-processing program etc. The I/O gamma translation table for referring to sign 4a by the processing of an I/O gamma conversion circuit mentioned later in this ROM4, The masking coefficient which refers to sign 4b by processing of the below-mentioned color-correction (masking) circuit, The shade distribution table for referring to the black generation which refers to sign 4c by the below-mentioned black generation and processing of a UCR circuit and a UCR table, and 4d of signs by processing of the below-mentioned shade distribution circuit, and sign 4e show the program group which stores various above-mentioned programs, respectively.

[0058] Moreover, a sign 5 shows RAM used as the work area in the case of the various program executions in ROM4, and momentary evacuation area at the time of error processing. And a sign 6 shows the processing section which performs picture signal processing mentioned later, and the sign 7 shows the printer section which forms a dot picture based on the picture signal processed in the picture signal processing section 6 at the time of record. Furthermore, a sign 8 shows the bus line which transmits the address signal in this equipment, data, a control signal, etc.

[0059] (Picture signal processing section) Next, the detail of the picture signal processing section 6 shown in drawing 8 is explained.

[0060] Drawing 9 is the block diagram showing an example of the circuit which constitutes the picture signal processing section 6 of this example.

[0061] The red transmitted from host equipment etc., green, and the picture luminance signals R, G, and B of each blue are inputted into the input gamma correction circuit 11, and are changed into cyanogen, a Magenta, and the picture concentration signals 21C, 21M, and 21Y of each yellow here. Color processing is performed in the color-correction (masking) circuit 12, and black generation and a UCR (lower color removal) circuit 13, and these signals are changed into cyanogen, a Magenta, yellow, and the new picture concentration signals 23C, 23M, 23Y, and 23K of black.

[0062] After, as for these picture concentration signals, the gamma correction was performed in the output gamma correction circuit 14, Picture concentration signal 25Ck corresponding to each ink of dark cyanogen with high color concentration, a dark Magenta, dark yellow, and dark black, 25Mk, 25Yk, 25Kk, and color concentration in the shade distribution circuit 15 A low, It can distribute to picture concentration signal 25Cu corresponding to each ink of light cyanogen, a

light Magenta, light yellow, and light black, 25Mu, 25Yu, and 25Ku.

[0063] Drawing 10 (A), (B), and (C) are the diagrams explaining the example of a shade distribution table, respectively.

[0064] For example, like this example, when the ink of the concentration of two sorts of shades is used, the translation table of drawing 10 (B) is used.

[0065] This table is set up as a picture concentration signal value and the optical reflection density value of the picture after record show proportionality linear relation. A picture concentration signal is changed into a dark ***** light signal based on this shade distribution table in a shade distribution circuit. ** — light — each picture concentration signal which was able to be distributed to each is made binary in the binary-ized circuit 6 In the printer section 7, this binary data is made into the **** signal of each recording head, from the ink delivery which corresponds according to a signal value from each recording head, ink is breathed out and a color picture is recorded.

[0066] (Printer section) Drawing 11 is the perspective diagram showing the important section composition of the color ink-jet recording device in the example of this invention.

[0067] Ink-jet unit 40k for dark ink which has the **** delivery train which breathes out ink-jet unit 40u for light ink which has the **** delivery train which breathes out separately black, cyanogen, a Magenta, and the light ink of each yellow, black and cyanogen, a Magenta, and the dark ink of each yellow keeps predetermined distance from carriage 41 mutually, and is installed in it. The guidance directions of the sliding are enabled by the guide shaft 43, and carriage 41 is made to carry out both-way movement along with the above-mentioned guide shaft 43 by the drive of the carriage motor 45 through the driving belt 44.

[0068] The heater element (electric thermal-conversion element) which generates the heat energy used for the ink regurgitation is prepared in the liquid route which is open for free passage to the ink delivery of each recording head of the ink-jet units 40u and 40k.

[0069] Ink supply in the correspondence delivery train of each ink-jet units 40u and 40k is performed through a predetermined supply way from each ink cartridge 48u and 48k. The interior is divided by the wall and these ink cartridges 48u and 48k store the ink of each concentration of yellow, a Magenta, cyanogen, and black. Moreover, the control signal to the ink JIETO units 40u and 40k etc. is sent through the flexible cable 49.

[0070] With the conveyance roller (un-illustrating) and the delivery roller 42 which make a non-illustrated conveyance motor a driving source, the recorded material which consists of a record form, plastics sheet metal, etc. is conveyed in the direction of an arrow, and record is made and it goes to the field which counters with movement of each ink-jet unit in the meantime. That is, according to the reading timing of an encoder which detects the move position of carriage 41, the above-mentioned heater element is driven based on a record signal, and a picture can be recorded for an ink drop by the regurgitation and making it adhere on a recorded material in order of the dark ink color of each color, and a light ink color.

[0071] The recovery unit 46 with the cap section 47 is arranged in the home position of the carriage 41 set up outside the record section by movement of carriage 41. When not recording, the ink delivery forming face of the ink-jet units 40u and 40k which are made to move carriage 41 to a home position, and correspond with each cap of the cap section 47 is sealed, and the blinding by adhesion of foreign matters, such as fixing of the ink resulting from ink solvent evaporation or dust, etc. is prevented.

[0072] Moreover, the above-mentioned cap section 47 attracts ink from the time of performing empty regurgitation mode in which ink is made to breathe out to cap circles, or an ink delivery in order to cancel the poor regurgitation and blinding of a low ink delivery of record frequency, and in case regurgitation recovery of the ink delivery which started the poor regurgitation is performed, it is used. Moreover, by arranging a blade in a cap section adjoining position, it is also possible to clean the ink delivery forming face of an ink-jet unit.

[0073] In addition, by preparing partition in each boundary in a cap's 47 vertical direction, it can prevent the ink in which suction etc. was carried out with the up side shifting to the bottom, and, thereby, quality-of-image degradation by color mixture etc. can be prevented.

[0074] (Ink-jet unit) Drawing 12 is the decomposition perspective diagram showing the

composition of the ink-jet units 40u or 40k used for this example.

[0075] The end of a circuit board 50 is mutually connected with the wiring portion of the heater board 51, and two or more pads for receiving the control signal from this device control section, a regurgitation signal, etc. are further prepared in the other end of a circuit board 50. Thereby, the electrical signal from a main frame control section comes to be supplied to each electric thermal-conversion element.

[0076] The metal support plate 52 which supports the rear face of a circuit board 50 at a flat surface also makes the bottom plate of an ink-jet unit. A pressure spring 53 presses elastically the field near the ink delivery of the fluting top plate 54 by the line, and, for the reason, has the hind legs of the couple in which a cross section receives the force of acting on the presser foot stitch tongue hooked using the clearance hole prepared in the portion bent and formed and base plate of the abbreviation configuration for U characters, and a spring, with a base plate. The pressure welding of a circuit board 50 and the fluting top plate 54 is carried out according to this spring force. Moreover, anchoring of the circuit board 50 to a base material is performed by attachment by adhesives etc.

[0077] Four ink supply pipes 55 are formed corresponding to each ink of yellow, a Magenta, cyanogen, and black. The filter 56 is formed in the edge of the ink supply pipe 55. The ink feed-zone material 57 is manufactured by mould fabrication, and the passage led-to each ink feed hopper of the fluting top plate 54 from a supply pipe 55 is formed. Fixation to the support plate 52 of the ink feed-zone material 57 is simply performed by making the holes 58 and 59 of a base material 52 carry out the penetration protrusion of the two pins by the side of the rear face of the ink feed-zone material 57 (un-illustrating), respectively, and carrying out heat weld of this.

[0078] Under the present circumstances, the crevice between the orifice-plate section 580 and the feed-zone material 57 is formed uniformly. An encapsulant is poured in from the up encapsulant inlet of the ink feed-zone material 57, it closes the crevice between the orifice-plate section 580 and the ink feed-zone material 57 at the same time it closes wire bonding, passes along the slot further established in the support plate 52, and closes completely the crevice between the orifice-plate section 580 and the support-plate 52 front-end section.

[0079] Drawing 13 is the perspective diagram which looked at the fluting top plate 54 mentioned above from the heater board 51 side.

[0080] The slot for common liquid rooms is established in yellow, a Magenta, cyanogen, and each four ink of black, each common liquid room is divided with Walls 60a-60c, and the feed hoppers 61a-61d for ink supply are formed in each common liquid room.

[0081] Slots 62a-62c are established in the pressure-welding side with the heater board 51 in the walls 60a-60c which divide each [these] common liquid room. This slot is open for free passage with the periphery section of the fluting top plate 54. After carrying out the pressure welding of *** 54 to a heater board and sticking it on it, the periphery section is closed by the encapsulant, as mentioned above. Under the present circumstances, along the above-mentioned slot, the encapsulant permeates and the crevice between *** and a heater board is filled. Thus, a common liquid room is completely separable at the process same with having been used by the conventional recording head. The structure of this slot changes with physical properties of an encapsulant, and it is necessary to make it into the configuration corresponding to each.

[0082] Thus, it becomes possible by dividing a common liquid room into plurality to supply ink which is different in each ink delivery.

[0083] Drawing 14 (A) is the ** type view which looked at the ink delivery train of the ink-jet units 40u and 40k from the recorded material side.

[0084] each with [as mentioned above in this example] yellow, a Magenta, cyanogen, and each ink delivery train of black to one — the object for dark ink, the object for light ink, and two ink-jet units 40u and 40k are used

[0085] 70Yk of ink-jet unit 40k, 70Mk, 70Ck, and 70Kk show ***** which breathes out yellow, a Magenta, cyanogen, and the dark ink of each black.

[0086] 71Yu of ink-jet unit 40u, 71Mu, 71Cu, and 71Ku show the delivery train which carries out the regurgitation of yellow, a Magenta, cyanogen, and the light ink of each black. The delivery train of each color has 32 deliveries in the pitch of 360 dots per inch (360dpi), and there is a

space for 8 dots between each color of these deliveries train with the wall between common liquid rooms.

[0087] Drawing 15 is the ** type view showing the image formation process using the ink-jet unit shown in drawing 14 (A).

[0088] The following explanation explains the space between each color as what is not.

[0089] When its attention was paid to the N+1st line, after record by the dark black Kk and the light black Ku was performed by the 1st scan, Conveyance operation (it omits a line feed and Following LF) of the recorded material of the specified quantity is performed. The record and LF by dark cyanogen Ck and light cyanogen Cu are performed by the 2nd scan, the record and LF by dark Magenta Mk and light Magenta Mu are performed by the 3rd scan, the record and LF by the dark yellow Yk and the light yellow Yu are performed by the 4th scan, and the N+1st-line record is completed. The amount of LF after each scanning record is a part for a delivery array length of 32 pieces of the delivery train of each color (length which added a part for a space in practice), and the picture for 32 deliveries is recorded by four scanning records.

[0090] Drawing 14 (B) is drawing showing other examples of the ink-jet units 40u and 40k.

[0091] In this example, what has each ink delivery train of a dark Magenta, dark cyanogen, and dark black, and the thing which has each ink delivery train of a light Magenta, light cyanogen, and dark yellow are used into the same ink-jet unit.

[0092] In drawing 14 (B), 72Kk of ink-jet unit 40k, 72Mk, and 72Ck show the delivery train which carries out the regurgitation of black, a Magenta, and each cyano dark ink. moreover . 73Yk of ink-jet unit 40u, 73Mk, and 73Cu show the delivery train which carries out the regurgitation of yellow, a Magenta, and each cyano light ink.

[0093] With this composition, only dark ink uses the yellow ink in which the graininess of a dot is not so much conspicuous by the picture bright section since lightness is high, and the black ink in which graininess is not so much conspicuous since it is used only in the high concentration section of a picture.

[0094] In this composition, yellow is used for a shade distribution table and, as for black, drawing 10 (A), a Magenta, and cyanogen use drawing 10 (B). Moreover, the number of deliveries of other colors **** the number of deliveries of 72Kk and 73Yk, and it shines. In the delivery train of each color, **, a light Magenta, **, and the object for light cyanogen have 32 deliveries in the pitch of 360 dots per inch (360dpi), and dark black and the object for dark yellow have 64 deliveries. Moreover, there is a space for eight deliveries between each color with the wall of a liquid room.

[0095] Drawing 16 is the ** type view showing the image formation process at the time of using the recording head of this composition shown in drawing 14 (B).

[0096] If its attention is paid to the N+1st line, the record and LF by the dark black Kk and the dark yellow Yk will be performed by the 2nd scan, the record and LF by dark cyanogen Ck and light cyanogen Cu will be performed by the 3rd scan, the record and LF by dark Magenta Mk and light Magenta Mu will be performed by the 4th scan, and the N+1st-line record will be completed. The amount of LF after each scanning record is a part for 32 delivery column width, and image recording for 32 delivery trains is performed by three scanning records.

[0097] In addition, record of dark yellow and dark black is performed every other scan, and a part for 64 double deliveries is recorded at a time compared with a Magenta and cyanogen.

[0098] By carrying out like this composition, when performing a black character and monochrome record, there is an advantage which can make recording rate quick by making the amount of LF adjustable at a part for 64-dot width of face.

[0099] Drawing 14 (C) is drawing showing the example of composition of further others of an ink-jet unit.

[0100] In this example, the object for dark ink, the object for light ink, and two ink-jet units are used for the thing with yellow, a Magenta, cyanogen, and each ink delivery train of black in the same ink-jet unit. However, as for yellow and black, both the ink-jets unit is using dark ink.

[0101] In drawing 14 (C), 74Yk of ink-jet unit 40k, 74Kk, 74Mk, and 74Ck are delivery trains which carry out the regurgitation of yellow, black, a Magenta, and each cyano dark ink.

[0102] 75Mk of ink-jet unit 40u, delivery train 75Kk to which 75Ck carries out the regurgitation

of a Magenta and each cyano light ink, and 75Yk are delivery trains which carry out the regurgitation of black and the dark ink of each yellow.

[0103] Since it is used like the composition described previously only in the high concentration section of the yellow ink in which the graininess of a dot is not conspicuous by the picture bright section since lightness is high, or a picture, only dark ink uses the black ink in which graininess is not conspicuous.

[0104] With this composition, drawing 10 (A), a Magenta, and cyanogen use drawing 10 (B) about yellow and black as a shade distribution table.

[0105] The delivery train of each color has 32 deliveries in the pitch of 360 dots per inch (360dpi), and there is a space for 8 dots between each color with the wall of a liquid room. Black and the delivery train for yellow are ****(ing) the number of deliveries of other colors by using two ink-jet units, and can record 64 dots simultaneously. Moreover, between yellow and black, a delivery train shifts and it is formed so that a blank may not arise.

[0106] Drawing 17 is the ** type view showing the image formation process at the time of using the ink-jet unit of composition of being shown in drawing 14 (C).

[0107] If its attention is paid to the N+1st line, the record and LF by the dark black Kk and the dark yellow Yk will be performed by the 2nd scanning eye, the record and LF by dark cyanogen Ck and light cyanogen Cu will be performed by the 3rd scanning eye, the record and LF by dark Magenta Mk and light Magenta Mu will be performed by the 4th scanning eye, and a picture will be completed by three scanning records. The amount of LF after each scanning record is a part for 32 delivery column width, and the picture for 32 delivery column width is recorded by three scanning records.

[0108] Record of dark yellow and dark black is performed every other scan of the 2nd scan and the 4th scan in the example shown in drawing, and 64 dots double by using the delivery train of two ink-jet units compared with a Magenta and cyanogen can be recorded at a time.

[0109] When performing a black character and monochrome printing like previous composition by carrying out like this composition, it is possible to make recording rate quick by carrying out adjustable [of the amount of LF] to a part for 64-dot width of face.

[0110] the above — also in which example of composition, in order not to record a total color at once in record process, a good picture also with little picture degradation by blot etc. is acquired Furthermore, in an actual ink-jet unit, since a space is between each color, the effect of the bond position of the writing scan of each color not being in agreement in each color like this illustration Ming, becoming a different position, and making generating of the bond line of a writing scan easing as a result is also acquired.

[0111] A liquid room is divided like this example, by using the ink-jet unit equipped with the ink delivery which carries out the regurgitation of the ink of a color which is different in the same delivery forming face, the number of ink-jet units (recording head) and the number of ink cartridges can be reduced, and the miniaturization of equipment is attained.

[0112] Moreover, since the ink-jet unit used for this example can manufacture the delivery train of a color which is different in the same delivery side often [precision] and at a low price, a high precision like equipment before and complicated amendment control become unnecessary, and low-pricing of it is also attained.

[0113] In addition, although it is more desirable for each color delivery train to arrange the ink-jet unit of this example on the same straight line from reduction-ization of ink regurgitation timing amendment, it may arrange each color delivery train lining up side-by-side, without being limited to this example, or may arrange it alternately.

[0114] Moreover, as this example explained, improvement in recording rate is also attained by changing the number of deliveries for every color if needed.

[0115] Furthermore, although the ink cartridge of this example is carried on carriage like the ink-jet unit, you may make it supply ink to an ink-jet unit through an ink supply cube, without uniting with an ink-jet unit and carrying on carriage. Moreover, although the direction which used the cartridge which divides the interior like this example and has ink of two or more colors is desirable in respect of an equipment miniaturization, you may make it use the ink cartridge of a single color, without dividing the interior.

[0116] Modification 1 (printer section) drawing 18 of an example 1 is the perspective diagram showing the important section composition of the color ink-jet recording device in the modification 1 of the above-mentioned example 1. The same sign is given to the element shown in drawing 11, and the same element, and the explanation is omitted. Suppose that it is the same also in drawing 19 and drawing 20 which are shown below.

[0117] the object for black ink which has the delivery train which carries out the regurgitation of the dark black ink, and the delivery train which carries out the regurgitation of the light black ink in this example — with ink-jet unit 110K Ink-jet unit 110C for cyano ink which has the delivery train which carries out the regurgitation of the dark cyanogen ink, and the delivery train which carries out the regurgitation of the light cyanogen ink, the object for Magenta ink which has the delivery train which carries out the regurgitation of the dark Magenta ink, and the delivery train which carries out the regurgitation of the light Magenta ink — with ink-jet unit 110M With ink-jet unit 110Y for yellow ink which has the delivery train which carries out the regurgitation of the dark yellow ink, and the delivery train which carries out the regurgitation of the light yellow ink, predetermined distance is kept from carriage 41 and it is installed in the direction of a writing scan.

[0118] (Ink-jet unit) Drawing 19 is the decomposition perspective diagram showing the composition of the ink-jet units 110K, 110C, 110M, and 110Y used for this example, and is the same as that of the composition shown in drawing 12 almost except fluting top-plate 54.

[0119] Drawing 20 is the perspective diagram which looked at the fluting top plate 54 of the ink-jet unit used for this example from the heater board 121 side. The common liquid room of this example is established in the object for dark ink, and two light ink, and each liquid room is divided with the wall 60. The feed hoppers 61a and 61b for ink being supplied are formed in each common liquid room.

[0120] Drawing 21 is drawing which looked at the ink delivery train of the above-mentioned ink-jet unit from the recorded material side. In this example, into the same ink-jet unit, it has each ink delivery train for the object for dark ink, and light ink, and an ink-jet unit is used corresponding to the ink of yellow, a Magenta, cyanogen, and black, respectively.

[0121] In drawing 21, the delivery train to which 143Yu, 142Mu, 141Cu, and 140Ku carry out the regurgitation of the light ink, 143Yk, 142Mk, 141Ck, and 140Kk are delivery trains which carry out the regurgitation of the dark ink.

[0122] The delivery train corresponding to each shade ink has 64 deliveries in the pitch of 360 dots per inch (360dpi), and there is a space for eight deliveries between each color with the wall of a common liquid room.

[0123] Drawing 25 is the ** type view showing the image formation process at the time of using the ink-jet unit shown in drawing 21.

[0124] If its attention is paid to the N+1st line, the record and LF by dark black, dark cyanogen, the dark Magenta, and dark yellow will be performed by the 1st scan, the record and LF by light black, light cyanogen, the light Magenta, and light yellow will be performed by the 2nd scan, and the N+1st-line record will be completed by two scanning records. The amount of LF after each scanning record is a part for 64 delivery trains, and the picture for 64 delivery trains is recorded by two scanning records.

[0125] Drawing 22 is the ** type view showing other examples of composition of an ink-jet unit.

[0126] In this example, into the same ink-jet unit, it has each ink delivery train for the object for dark ink, the object for inside concentration ink, and light ink, and each ink-jet unit is used corresponding to each ink of yellow, a Magenta, cyanogen, and black. In this composition, a shade distribution table uses what is shown in drawing 10 (C).

[0127] In drawing 22, 153Yu(s), 152Mu, 151Cu, ***** to which 150Ku breathes out light ink, 153Ym, 152Mm, 151Cm, ***** that breathes out inside concentration ink 150km, 153Yk, 152Mk, 151Ck, and 150Kk are ***** which breathe out dark ink, respectively.

[0128] The delivery train corresponding to light ink has 64 deliveries in the pitch of 360 dots per inch (360dpi), and there is a space for 8 dots between each color into each ** with the wall of a common liquid room.

[0129] In this example, the record and LF by dark black, dark cyanogen, the dark Magenta, and

dark yellow are performed by the 1st scan, the record and LF by inside black, inside cyanogen, the inside Magenta, and inside yellow are performed by the 2nd scan, the record and LF by light black, light cyanogen, the light Magenta, and light yellow are performed by the 3rd scan, and a picture is completed by three scanning records. The amount of LF after each writing scan is a part for 32 delivery trains, and the picture for 32 delivery trains is recorded by three scanning records.

[0130] Like this composition, in addition to shade ink, it becomes impossible for a granular feeling to be conspicuous in a whole floor tone field by using inside concentration ink, each concentration ink can be changed further smoothly, generating of a false profile can also be prevented, and still smoother gradation reappearance is attained.

[0131] Drawing 23 is the ** type view showing the example of composition of further others of an ink-jet unit.

[0132] In this example, it is used combining a thing with each ink delivery train for the object for dark ink, and light ink, and a thing with the ink delivery of a single color in the same ink-jet unit.

[0133] In drawing 23 , 162Mu(s), ***** to which 161Cu breathes out light ink, 163Yk, 162Mk, 161Ck, and 160Kk are ***** which breathe out dark ink, respectively. The number of deliveries of delivery train 160Kk and 163Yk is twice the number of deliveries of the delivery train of other colors.

[0134] Only dark ink is used about the yellow ink in which the graininess of a dot is not [a picture bright section] conspicuous since lightness is high, and the black ink in which graininess is not conspicuous since it is used only in the concentration section of a picture. In this composition, a shade distribution table uses [cyanogen / drawing 10 (A) a Magenta, and] what is shown in drawing 10 (B) about yellow and black.

[0135] Drawing 26 is the ** type view showing the image formation process at the time of using the ink-jet unit shown in drawing 23 .

[0136] In this drawing, if its attention is paid to the N+2nd line, the record and LF by dark black, dark cyanogen, the dark Magenta, and dark yellow will be performed by the 2nd scan, the record and LF by light cyanogen and the light Magenta will be performed by the 3rd scan, and a picture will be completed by two scanning records. The amount of LF after each scanning record is a part for 64 delivery trains, and can perform image recording for 64 delivery trains by two scanning records.

[0137] Record of dark yellow and dark black is only the 2nd scan among drawing, and is performed every other scan, and a part for 128 double delivery trains is recorded at a time as compared with a Magenta and cyanogen.

[0138] When performing a black character and monochrome printing like the above-mentioned example by carrying out like this composition, recording rate can be raised by making the amount of LF adjustable at a part for 128-dot width of face.

[0139] Drawing 24 is the ** type view showing the example of composition of further others of an ink-jet unit.

[0140] In this example, the unit which has the delivery train from which it has each ink delivery train for the object for dark ink and light ink in the same ink-jet unit, and ink discharge quantity differs is used.

[0141] In drawing 24 , ***** to which 173Yus, 172Mus, 171Cus, and 170Kus breathe out the small drop of the light ink of each color, 173Yul, 172Mul, 171Cul, and 170Kul are ***** which breathe out the large drop of the light ink of each color.

[0142] ***** to which 173Yks(es), 172Mks, 171Cks, and 170Kks breathe out the small drop of the dark ink of each color, 173Ykl, 172Mkl, 171Ckl, and 170Kkl are ***** which breathe out the large drop of the dark ink of each color.

[0143] The amounts of ink drops of a small drop are about 20 pl(s), and the amounts of ink drops of a large drop are about 40 pl(s).

[0144] Drawing 27 is the ** type view showing the image formation process at the time of using the ink-jet unit shown in drawing 24 .

[0145] If its attention is paid to the N+1st line, the record and LF by the small drop of dark black, dark cyanogen, a dark Magenta, and dark yellow will be performed by the 1st scan. The record

and LF by the large drop of dark black, dark cyanogen, a dark Magenta, and dark yellow are performed by the 2nd scan. The record and LF by the small drop of light black, light cyanogen, a light Magenta, and light yellow are performed by the 3rd scan, the record and LF by the large drop of light black, light cyanogen, a light Magenta, and light yellow are performed by the 4th scan, and the N+1st-line record is completed by four scanning records. The amount of LF after each scanning record is a part for 32 delivery trains, and can perform image recording for 32 delivery trains by 4 times of writing scans.

[0146] this composition — like — ** and light ink — adding — the diameter of a dot — ***** — by recording combining a thing, it stops being conspicuous in a granular feeling in a whole floor tone field, and further, the change of each concentration ink can carry out smoothly, and can also prevent generating of a false profile, and the still smoother gradation reappearance of it is attained

[0147] the above — also in which composition, like the above-mentioned example, in order not to record a total color at once, a good picture also with little picture degradation by blot etc. is acquired Furthermore, in an actual ink-jet unit, since a space is between the delivery trains of each color, the effect of becoming each position which did not carry out color coincidence but is different, and making generating of the bond line of a writing scan easing as a result is also acquired like this illustration Ming in the bond position of the writing scan of each color.

[0148] Moreover, according to the composition explained in this modification, the ink of a same color system can be packed in one ink-jet unit, and there is an effect also in share-sizing of an ink cartridge, and relief of the color mixture which is easy to generate at the time of regurgitation recovery action. Even if an ink lappet lump arises in suction operation by regurgitation recovery action by arranging the delivery train of the low ink (light ink) of concentration to the up side, and arranging ink with high concentration (dark ink) to the down side especially, ink color mixture can be prevented.

[0149] A common liquid room is divided, by using the ink-jet unit which equipped one with the ink delivery which carries out the regurgitation of the ink of a color which is different in the same delivery forming face, the number of ink-jet units (recording head) and the number of ink cartridges can be reduced, and the miniaturization of equipment also of this modification is attained the same by the previous example. Moreover, since the ink-jet unit used for this example can also form the delivery train of a color which is different in the same delivery side often [precision] and at a low price, a high precision like equipment before and complicated amendment control become unnecessary, and low-pricing of it is also attained.

[0150] In addition, also in the ink-jet unit of this example, although it is more desirable for each color delivery train to arrange on the same straight line from reduction-ization of ink *** timing amendment, each color delivery train may be arranged lining up side-by-side, without being limited to this example, or you may arrange alternately.

[0151] Moreover, as this modification explained, improvement in recording rate is also attained by changing the number of deliveries for every color if needed.

[0152] Furthermore, although the ink cartridge of this modification is carried on carriage like the ink-jet unit, you may make it supply ink to an ink-jet unit through an ink supply tube, without uniting with an ink-jet unit and carrying on carriage. Moreover, although the direction which used the cartridge which divides the interior like this example and has ink of two or more colors is desirable in respect of an equipment miniaturization, you may make it use the ink cartridge of a single color, without dividing the interior.

[0153] Modification 2 drawing 28 of an example 1 is the ** type view which looked at the ink-jet unit concerning other modifications of an example 1 from the recorded material side.

[0154] The ink-jet unit of this example establishes at one all the ink delivery trains corresponding to the total ink color used for record in the same ink-jet unit. The delivery train to which 210Yu carries out the regurgitation of the color ink of light yellow in the ink-jet unit 210, The delivery train to which 210Mu(s) carry out the regurgitation of the color ink of a light Magenta, the delivery train to which 210Cu carries out the regurgitation of the color ink of light cyanogen, The delivery train to which 210Ku(s) carry out the regurgitation of the color ink of light black, the delivery train to which 210Yk carries out the regurgitation of the color ink of dark

yellow, The delivery train to which 210Mk(s) carry out the regurgitation of the color ink of a dark Magenta, the delivery train to which 210Ck carries out the regurgitation of the color ink of dark cyanogen, and 210Kk are delivery trains which carry out the regurgitation of the color ink of dark black. Each color ink delivery train has a space for 8 dots with the wall of a common liquid room between the delivery trains of each color with 32 deliveries in the pitch of 360 dots per inch (360dpi).

[0155] The record and LF by dark black are performed by the 1st scan, and the record and LF by light black are performed by the 2nd scan. The record and LF by dark cyanogen are performed by the 3rd scan, and the record and LF by light cyanogen are performed by the 4th scan. The record and LF by the dark Magenta are performed by the 5th scan, the record and LF by the light Magenta are performed by the 6th scan, the record and LF by dark yellow are performed by the 7th scan, the record and LF by light yellow are performed by octavus scan, and record of each line is completed by eight scanning records. The amount of LF after each scanning record is a part for 32 delivery trains, and can perform image recording for 32 delivery trains by 8 times of writing scans.

[0156] Also in this composition, like a previous example, in order not to record a total color at once, a good picture also with little picture degradation by blot etc. is acquired. Furthermore, in an actual ink-jet unit, since a space is between each color, the effect of becoming each position which did not carry out color coincidence but is different, and making generating of the bond line of a writing scan easing as a result is also acquired like this illustration Ming in the bond position of the writing scan of each color.

[0157] The ink-jet unit of this example can be built with a precision sufficient to the same delivery forming face by the ink delivery train of a total color, and does not have the problem of the registration gap between each color.

[0158] Moreover, although it is more desirable to arrange the **** timing between each color on [all] a color same straight line like this example since there is no amendment need, each ***** may be arranged lining up side-by-side, without being limited to this example, or you may arrange alternately.

[0159] Moreover, improvement in recording rate is also attained by changing the number of deliveries for every color if needed.

[0160] A common liquid room is divided, by using the ink-jet unit equipped with the ** ink delivery which breathes out the ink of a color which is different in the same delivery forming face, the number of ink-jet units (recording head) and the number of ink cartridges can be reduced, and the miniaturization of equipment also of this example is attained the same by each previous example. Moreover, an advanced equipment precision like equipment before and complicated amendment control become unnecessary, and low-pricing is also possible.

[0161] Although it is desirable to carry on carriage like an ink-jet unit as for a pan ink cartridge, you may make it supply ink to an ink-jet unit through an ink supply tube, without uniting with an ink-jet unit and carrying on carriage. Moreover, although the direction which used the cartridge which divides the interior and has ink of two or more colors is desirable in respect of an equipment miniaturization, you may make it use the ink cartridge of a single color, without dividing the interior.

[0162] Modification 3 drawing 29 of an example 1 shows the structure of the one apparatus ink-jet cartridge which assembled the ink-jet unit 224 of yellow, a Magenta, cyanogen, and black four colors each in one by the frame 220.

[0163] Since the previous example explains the composition of the ink-jet unit 224 in detail, it omits explanation here.

[0164] Four ink-jet units 224 are attached at the predetermined intervals in a frame 220, and where the registration of the direction of a delivery train is moreover also adjusted, they are fixed. 221 is covering of a frame and 222 is a connector for connecting the electrical signal from a pad and the main frame formed in the circuit board 120 of four ink-jet units 224. The circuit board 120 and the connector 222 are connected by the electrode 223.

[0165] Drawing 30 shows the situation when carrying the above-mentioned one apparatus ink-jet cartridge 222 in carriage.

[0166] It divides, and is divided into the room of two upper and lower sides by 230, and the ink tank 118 has filled up the lower room with dark ink for light ink in the upper room. And ink is supplied to the ink delivery train which pressure-welding combination of the ink-jet cartridge 222, and yellow, a Magenta, cyanogen and four ink tanks 118 of black is carried out on carriage, and corresponds from the ink tank 118.

[0167] Also in the ink-jet unit of this composition, like each previous example, in order not to record a total color at once, a good picture also with little picture degradation by blot etc. is acquired. Furthermore, in an actual ink-jet unit, since a space is between each color delivery train, the bond position of the writing scan of each color does not carry out each color coincidence, but the effect of becoming a different position and making generating of the bond line of a writing scan easing as a result is also acquired.

[0168] As for the one ink-jet cartridge of this example, it is possible for two or more ink delivery trains to put in order the ink-jet unit built with a precision sufficient to the same delivery forming face with a sufficient precision, and to really finish setting it up to a cartridge, it can solve the problem of the registration gap between each ink-jet unit, and the load of amendment control reduces it. Moreover, it is possible to communalize the electric contact section of each ink-jet unit, and the number of contacts with the main part of equipment can be reduced.

[0169] Although it is more desirable to arrange the ****-timing-between each color on [all]-a color same straight line since each delivery train in an ink-jet unit does not have the amendment need, it may arrange each ***** lining up side-by-side, without being limited to this example, or may arrange it alternately, respectively.

[0170] Moreover, improvement in recording rate is also attained by changing the number of deliveries for every color if needed.

[0171] Furthermore, although it is desirable to carry on carriage like an ink-jet cartridge as for an ink cartridge, you may make it supply ink to an ink-jet cartridge through an ink supply cube, without uniting with an ink-jet cartridge and carrying on carriage. Moreover, although the direction which used the cartridge which divides the interior and has ink of two or more colors is desirable in respect of an equipment miniaturization, you may make it use the ink cartridge of a single color, without dividing the interior.

[0172] In addition, an advanced equipment precision like equipment before and complicated amendment control are attained by the miniaturization of equipment for it to be unnecessary, and this example as well as a previous example can also be fallen by the price.

[0173] In the example of four modifications of an example 1, the pixel position recorded by each writing scan is arranged so that it may become alternate about the pixel county of 1 x 2 pixels.

[0174] Hereafter, record of this example is explained with reference to drawing 31. In the 1st writing scan, the delivery in the lower half of [four] a light ink portion is used among the deliveries of a total of 16 pieces of an ink delivery train. At this time, the pixel array to record records the half which are all the pixels that are what made 1x2 pixels alternate, and can record the above-mentioned delivery (a pixel is thinned out and recorded on a half). After the 1st writing scan end, while, as for the recording paper, only 4-pixel width of face is sent in the direction of an arrow, a recording head unit is returned to a record starting position by the *****.

[0175] In the 2nd following writing scan, record is performed using the delivery of a total of eight pieces of light ink. At this time, the pixel recorded is the portion which arranged 1x2 pixels alternately similarly among the field of the 4-pixel width of face which was not recorded by the 1st writing scan, and the picture field of the 4-pixel width of face following this (infanticide contrary to the time of the 1st writing scan is performed).

[0176] After performing the ejection of 4-pixel width of face again and returning a recording head to a record starting position, the 3rd writing scan is performed. The delivery used here is a delivery of four lower halves the delivery of a total of eight light ink, and among dark ink delivery trains. The pixel array recorded at this time records the half which are all the pixels that are the same things as the time of the 1st writing scan which made 1x2 pixels alternate, and can record the above-mentioned delivery (a pixel is thinned out and recorded on a half).

[0177] All the deliveries of a recording head unit are used for the first time by the 4th following

writing scan. The pixel which arranged 1x2 pixels alternately by infanticide contrary to the 3rd writing scan is recorded.

[0178] And all records to the 1st pixel record are completed by this writing scan.

[0179] Hereafter, a picture is completed by repeating record similarly.

[0180] ***** by the concentration unevenness by dispersion and record-medium conveyance unevenness of a **** property and white **** can be made to ease by using the above division record methods, and a good picture can be offered.

[0181] In the above-mentioned example, you may use an alternate infanticide pattern, without being limited to this, although the infanticide pattern which made 1x2 pixels alternate was used.

[0182] Furthermore, the composition of a recording head unit is not restricted to this example, but can be applied to the thing of the above and all composition of that each example explained.

[0183] In addition, the example of all above is an effective means also to a monochrome image not only like color picture record but gray-scale record.

[0184] According to the example 1 explained above and its modification, in addition to the various effects mentioned above, the following effects can also be acquired.

[0185] As each above-mentioned example showed, since ** and ***** which breathes out light ink, respectively can be prepared, register doubling between the record dots of each color or-between the record dots of each shade becomes easy about ***** which breathes out the ink of a different kind in the same ink-jet unit, i.e., the ink of Y, M, C, and K, or of-the-same-kind ink.

[0186] Moreover, if it is in the composition which prepares ** which was mentioned above, and ***** which breathes out light **, Inc. in the same ink-jet unit, since the operating frequency of the shade ink of these same system color is almost equal, exchange of the ink-jet unit which made the ink tank one can be performed, without making ink so useless.

[0187] The example 2 shown below and its modification fully reduce the irregular color in the case of color record, shade unevenness, a stripe, etc. using the relation of the delivery array of each ink shown in an example 1 and its modification.

[0188] Therefore, in the following examples, the ink-jet unit which does so the effect by unification of the delivery train of each ink by the example 1 and its modification can also be used, or only the relation of the delivery array of each ink is the same as that of example 1 grade, and the composition with which each delivery train is not united can also be used.

[0189] In addition, in the example shown below, an example 1 or its modification should show an equipment configuration and control composition.

[0190] Example 2 drawing 32 is the ** type view showing the composition of the ink-jet unit (henceforth a recording head) used for the example 2 of this invention.

[0191] In this example, black (K), cyanogen (C), the Magenta (M), and the recording head which four colors each of yellow (Y) became independent of have a total of 16 deliveries of eight deliveries of dark ink *****, and eight deliveries of light ink *****, respectively. Delivery arrangement of each ink of this recording head is the same as that of the delivery arrangement shown in drawing 21, and can also make each delivery train one.

[0192] The writing scan and ejection of a recording head are made in the direction shown by the arrow in drawing, and it is carried out by the width of face for four deliveries for every writing scan about an ejection. According to the composition of this example, since the recording paper is sent toward a dark ink record section from a light ink record section, after a light ink picture always completes record, a dark ink picture is recorded. Thus, if it is made the composition which arranges ** and the delivery train of light **, Inc. in one train in the direction of an ejection, since ** and the order of placing of light **, Inc. will not be reversed in the outward trip and return trip of both-directions record, the shade unevenness which originated in order of placing of ink can be prevented beforehand.

[0193] Since it is characterized by to carry out division record using ***** which breathes out the ink in which concentration differs further about each of two or more kinds of ink in which colors differ, in this example, the effect of division record can demonstrate also in the composition which the delivery train of the ink of all kinds as shown in drawing 7 has arranged in the direction of a writing scan. However, with such composition, irregular color evil is

not yet solved in many cases completely.

[0194] This reason is explained below using drawing 33 (A) and (B).

[0195] Usually, the amount of ink drops let is designed so that it may spread greatly somewhat rather than the area given to each pixel on space. This is for making it not seen [the portion of a blank paper] to the field of 100% of rates of printing. Therefore, although it is recorded about 50% of the number of record pixels when the division recording method is performed, as a record medium-ed (recording paper) is shown in drawing 32 (A), 50% or more of field will be covered. In addition, the amount of ink by which dark ink and light ink will be driven into per pixel if the dark ink and light ink of two or more colors are further recorded on the same pixel for color mixture record increases by 4 times, it oozes out and a field will be in the state almost near 100% (drawing 32 (B)). For this reason, even if it records an ink dot on the thinned-out pixel, since the first dot already occupies the portion, the concentration of the color of next ink does not become so high. Therefore, even when line record is both performed by division record, the picture field where the color tone of the scanning direction when being first recorded on space and concentration serve as [at] a priority color in the whole record section, and outward trip record turns into the first record, and the picture field where return trip printing serves as the first record serve as an irregular color by turns, it appears, and this degrades a picture in many cases remarkably.

[0196] In this example, the state of recording a uniform green picture is shown in drawing 34 .

[0197] The uniform green picture said here is a picture on which cyanogen and yellow record both dark ink and light ink, and an input picture concentration signal points out the duty between 128 and 255 in the distribution table shown in drawing 10 (B). However, in the detail of the following containing this example, the state where the four above-mentioned sorts of ink was recorded on all pixels on account of explanation was set up.

[0198] In this example, the pixel position recorded by each writing scan is arranged so that it may become alternate about the pixel group of 1 x 2 pixels. By doing in this way, rather than the arrangement which makes alternate the 1-pixel unit shown by drawing 33 , since it can ooze and ** can be decreased, a himself is devoted and already explained irregular colors by order other than the record pixel in each writing scan stop being able to happen easily.

[0199] Hereafter, in drawing 34 , it explains briefly for every writing scan.

[0200] In the 1st writing scan, four deliveries in the lower half of a light ink portion are used among all 16 deliveries in a recording head. The pixel array recorded at this time is what made 1x2 pixels alternate, and records the half which are all the pixels that can record the above-mentioned delivery. In the 1st writing scan, since it records while a recording head scans in the direction of an outward trip, when recording a uniform green picture, ink is driven in in order of cyanogen and yellow to each record pixel. Therefore, in the pixel recorded by the 1st writing scan, a green picture with strong coloring of cyanogen will be acquired. As for the recording paper, only 4-pixel width of face is sent in the direction of the arrow in drawing after the 1st writing scan end.

[0201] In the 2nd following writing scan, all 8 deliveries of light ink are used in the direction of a return trip, and it is recorded on it. The pixel recorded at this time is the portion of the array which made 1x2 pixels alternate similarly among the field of the 4-pixel width of face which was not recorded by the 1st writing scan, and the picture field of the 4-pixel width of face following this. In the 2nd writing scan, since it is recorded in the direction of a return trip, the ink impact to a record pixel becomes the order of yellow and cyanogen. Therefore, in the pixel recorded by the 2nd writing scan, coloring of yellow serves as a strong green picture. However, since the ink of concentration recorded by the 1st and 2nd writing scans is thin from the first, there is no difference of the coloring nature by the order of ink placing what appears so greatly.

[0202] Again, the 3rd writing scan is performed in the direction of an outward trip after the ejection of 4-pixel width of face. The deliveries used here are four deliveries of a lower half among light ink all 8 deliveries and a dark ink delivery. since this writing scan is record of the direction of an outward trip again — the [the 2nd and] — in the light ink field of 3 picture field, it is cyanogen and the order of ink placing of the order of yellow, and a green pixel with strong coloring of cyanogen will be obtained On the other hand, in the 1st picture field, since printing in

light ink will accomplish and the priority color will already be determined by light ink, even if dark ink is driven in in order of cyanogen and yellow, there is no determination of the priority color by this, and it is only that the concentration of green becomes high on the whole.

[0203] All the deliveries of a recording head are used for the first time to the 1st picture field by the 4th following writing scan. Since this writing scan is a return trip scan again, ink is driven in in order of yellow and cyanogen. Since it is the 1st picture field and record when it reached and light ink has already reached the target in the 2nd picture field as the 3rd writing scan explained, the order of ink placing of dark ink hardly influences a picture, but it is only that the concentration of green becomes high on the whole as for both the picture field. And by this writing scan, all records to the 1st picture field are completed. the [the 3rd and] — about 4 picture field, the priority color in a record pixel is determined like the old writing scan by the order of placing of ink

[0204] Like the following, using all 16 deliveries, an ejection scan and both-way record of 4 delivery trains are repeated successively, and it goes by each writing scan.

[0205] according to the method explained above, after making all the picture fields that stand in a row 4-pixel width of face every by using a recording head as shown in drawing 32 complete a light ink picture by the first two scans, the dark ink picture is completed by two continuing scans. Therefore, the factor itself in which shade unevenness like the conventional example appears also by the method of recording using shade ink will already be removed by this example.

[0206] On the other hand, about the irregular color of another evil by the order of ink placing, it has composition which records the dot of a color tone which is different in an outward trip and a return trip. however, the case of drawing 33 explained in the conventional example since the pixel recorded perform division record in this example, and simultaneous was made into 1x2 units — further — a another province region — it oozes and ** can be stopped. Therefore, an almost equal still better picture is acquired in each picture field in the rate of the area which the dot of the area which the dot recorded on the outward trip occupies recorded in the return trip occupies comparatively.

[0207] If based on such an idea, it can expect solving an irregular color and shade unevenness simultaneously also by the recording head of composition like the conventional example (drawing 7) by expanding further the pixel array now made into the size of 1x2. If it actually does in this way, surely the overall color tone in each picture field may become equal. However, if the unit of a pixel array is too large on the other hand, itself will come to be sensed visually shortly, a feeling of ZARATSUKI will appear on a picture, and it will become what smoothness lacked. Moreover, simultaneously, since a maximum of 400% or more of ink will be driven in to this pixel, a blot arises in the unique boundary section to it, and it will be easy to become not desirable in the high field of recording density to it.

[0208] this example is the delivery array composition of each ink color about the former, copes with it and is making two evils of the shade unevenness and irregular color which may happen in case both-directions record is performed solved by division record and pixel composition about the latter. And especially, by old explanation, after recording light ink previously, the head composition on which dark ink is made to record is taken. However, the order of placing of shade ink itself is not what was restricted to this. That is, it is a book even if it takes composition which reverses the position of a light ink nozzle and a dark ink nozzle.

[0209] Here, the picture comparison in the case of the recording head composition shown by drawing 32 which has so far explained, and composition of having reversed this composition and shade is explained briefly.

[0210] When light ink is recorded previously, a big dot with low concentration is obtained in a wraparound and each pixel by the light ink bottom in which the dark ink which reaches the target after that is already recorded. On the other hand, when dark ink is recorded previously, the dot of the priority color decided in the direction of a writing scan of the No. 1 beginning reaches the target by high concentration, and determines a priority color quite strongly. In this case, about an irregular color, the composition of completing light ink previously cannot appear easily from the composition which records dark ink previously. This can be said since there are few differences of the coloring nature by the order of ink placing in light ink than that in dark ink. Furthermore,

since each dot spreads uniformly greatly, a picture smooth on the whole can be acquired. therefore, also in this example, the direction of a recording head with the array which records light ink previously is alike, receives a color image picture, and it can call it the composition to which it was more suitable

[0211] On the other hand, since it is not obscured in the light ink in which dark ink is recorded after that although surely an irregular color tends to be conspicuous when dark ink is recorded previously, the concentration and resolution of each pixel itself are high, and the picture of high resolving carried out distinctly is acquired. Therefore, the head which records dark ink previously can call it the composition for which it was suitable with the black character picture with high concentration etc.

[0212] In this example, although two kinds of concentration ink, dark ink and light ink, has explained each color, in order to make a picture good further, it is still better as for three or more kinds in the level of concentration. In this case, what is necessary is just to make the delivery train of the ink in which concentration differs arrange in the direction of an ejection, as shown in drawing 35.

[0213] In a color ink-jet recording device with the recording head which carries out the regurgitation of the shade ink according to [as explained above] this example, by arranging each color ink in the direction of a head writing scan, and making a shade ink delivery arrange in the direction of an ejection, the irregular color and shade unevenness which originate in order of ink placing in the case of both-directions record can be abolished, and a good picture can be acquired.

[0214] ** is just explained to the modification 1 of an example 2, next the modification of the above-mentioned example 2. It is head composition, i.e., delivery array composition, about shade unevenness, and to having solved the irregular color by the division recording method, by this example, the above-mentioned example 2 is the division recording method about shade unevenness, and cancels an irregular color with head composition.

[0215] The recording head composition of this modification is shown in drawing 36. Although the recording head which arranges 16 deliveries in one train is used like [this modification] the above-mentioned example 2, a dark ink head and a light ink head are made to become independent here, and it is made to stand in a row in the direction of a writing scan. Each delivery train is making it arrange four deliveries of each color at a time toward the direction of an ejection.

[0216] Although the color order of record is made into black, cyanogen, a Magenta, and yellow in this example, the order of an array of the direction of an ejection is not restricted to one kind like an example 2. Moreover, in this example, since only four deliveries have the delivery with them per each color and each concentration, in order to perform division record, the amount of ejections for every writing scan serves as 2-pixel width of face.

[0217] Drawing 37 shows the record state when recording by this example. The case where a uniform green picture is recorded with cyanogen and yellow is taken for the example like the example 2 also here.

[0218] In the start of record, although the nose of cam of a form is set as a black delivery position when black data exist, since it is not necessary to record black ink, by the green picture explained by this example, a record form is moved to the delivery position of cyanogen, as shown in this drawing. Although four deliveries of cyanogen deliveries exist in all at this time, in order to perform division record, by the 1st writing scan, a record form is set as the position of two deliveries in the lower half of a cyano delivery.

[0219] Since the 1st writing scan is outward trip record, to a record pixel, it reaches the target in order of the cyanogen of dark ink, and the cyanogen of light ink. Since dark ink reaches the target previously, in the pixel recorded here, it becomes the form where a big cyano dot with thin concentration surrounds thinly the surroundings of the cyanogen in which concentration is high and the dot profile clarified. Then, the ejection of 2-pixel width of face is performed, and it continues to the 2nd following writing scan. In addition, the pixel array simultaneously recorded by each writing scan by this example as well as the above-mentioned example 2 uses that to which the pixel group of 1x2 became alternate.

[0220] The 2nd writing scan is a return trip scan, and ink reaches the target to each pixel in order of the cyanogen of light ink, and the cyanogen of dark ink. The dot of the dark ink recorded after light ink already reaches the target sinks into the surroundings of the dot of light ink greatly, and becomes what has concentration lower than the dot obtained by outward trip scan uniform. In the 1st picture field which record of cyanogen completes by 2 times of the writing scans so far, a cyano dot with high concentration and the low cyanogen dot of concentration will be intermingled an abbreviation moiety every. Moreover, in the 2nd picture field following this 1st picture field, the half of a cyano dot is recorded by the return trip record at this time.

[0221] In the 3rd and 4th following writing scans, since the 1st picture field is located corresponding to the Magenta delivery section, actual record is not performed. However, record of a cyanogen dot is made one by one in each picture field located in the cyano delivery section below in the 2nd picture field following this.

[0222] That the 1st picture field where record of a cyano dot was made is recorded on a degree is the 5th writing scan in which this field is located corresponding to the yellow delivery section. Yellow ink reaches the target in order of the upper shell and dark ink in which cyano ink is already recorded, and light ink. Since cyano ink will already be absorbed and it will be recorded above although a record pixel turns into a yellow pixel with high concentration if ink is struck by this turn on a blank paper, yellow ink is large to the surroundings of cyano ink, or the down side, and neither a wraparound, a dot configuration nor the difference in a shade appears here.

[0223] When repeating the writing scan both ways successively as mentioned above, when located in the cyano delivery section, and only when it is located in the yellow delivery section after 2 scans, record has accomplished in each picture field. Here, since yellow is recorded after record of cyanogen is completed in all picture fields, the irregular color evil at the time of the both-way record explained in the conventional example is solved by the recording head composition of this example.

[0224] In the color ink-jet recording device which had a shade ink head according to [as explained above] this modification, by arranging the delivery of shade ink in the direction of a writing scan, and making each color ink delivery arrange in the direction of an ejection, the irregular color and shade unevenness which originate in order of ink placing in the case of both-directions record can be abolished, and a good picture can be acquired.

[0225] In addition, in this example, the turn of the ink color arranged in the direction of an ejection is not what was restricted to one kind. Any arrays can acquire the same effect in this invention. Having brought black ink to the head especially by this example means to make the concentration and resolution of black ink the highest in four colors, and that the concentration of black ink and resolution are high leads to acquiring a clear black character picture.

[0226] The modification 2 of an example 2, next other modifications of an example 2 are explained.

[0227] One head was made to correspond at a time with a color or concentration in the example 2 mentioned above and its modification 1 using two or more recording heads, respectively. On the other hand, the number of the recording heads used for this example is one. That is, as shown in the example 1 grade, the ink delivery corresponding to all concentration and colors is constituted in ******, and these are beforehand constituted in this recording head at one.

[0228] Drawing 38 is the ** type view showing the composition of the recording head used for this example.

[0229] It has eight deliveries of eight pieces and light ink for the delivery of dark ink about each color ink, respectively, and record of one color is completed by a total of 16 deliveries. Although the delivery group of each color is arranged in the direction of an ejection in order of black (K), cyanogen (C), a Magenta (M), and yellow (Y), the delivery groups of ***** each color overlap by one delivery mutually at this time.

[0230] In drawing 38 , the horizontal line shown as the solid line on the head is also what showed the ejection state, and the head pixel of the recording paper is the ejection scan of 4-pixel width of face, and showed one by one which ***** it was. When delivery array composition like this example is taken so that it may see to this drawing, this head pixel will be located in a different portion for every color of each eight deliveries which carry out a color array. That is,

although this head pixel may serve as the bond section of division record in black, the bond section does not become in cyanogen, a Magenta, and yellow.

[0231] The record state by the example shown in drawing 39 is shown as a state which records a uniform green picture like each above-mentioned example. Since it is the same as that of the above-mentioned modification 1 that the ink delivery of a different color has also arranged this example in the direction of an ejection, in both-way record of each writing scan, only cyanogen or the picture field which came to the delivery position of yellow will be recorded. The picture field said here points out the thing of the field of the 4-pixel width of face which each color recording head records simultaneously, namely, it ties with the bond section of each color, and the thing of the field between the sections is said. therefore, the picture field of an example old in this example — differing — each color — respectively — mutual — the picture field will be constituted

[0232] Drawing 40 shows the bond section (picture field) of the record picture after the 6th writing scan in drawing 39 , and each color. Here, it is shown that each bond section (picture field) has appeared in the position where 1 pixel of each color shifted at a time, respectively. Thus, the book stated in the above-mentioned example 2 and the modification 1 so far by making it appear in a position which tied for every color and is different in the section

[0233] By the way, although it constituted from this example so that the delivery position in a recording head might be piled up each color of one every delivery in order to tie for every color and to change a position, the delivery array composition for changing a bond position is not what was restricted to this array. For example, even if it detaches 1 pixel at a time conversely and makes each color arrange, the same effect is acquired and can exclude completely the element of the irregular color by both-directions record in this case.

[0234] Moreover, in order to make the partition portion between each common liquid room in a recording head into a positive thing, it is desirable also in a recording head creation process to keep a certain amount of distance and to arrange a delivery train.

[0235] Furthermore, if the increase of the number of the deliveries which participate in record, and the amount of ejections also become large, the bond section of each color can be appeared in various positions.

[0236] Furthermore, the turn of the ink color arranged in the direction of an ejection like the above-mentioned modification 1 also in this example is not what was restricted to one kind. An effect with any same arrays can be acquired.

[0237] In the example 2 and modifications 1 and 2 which were explained above, although the image formation by 2 division records was altogether explained for the example, the division record with more much number of partitions is also possible as a means for making the effect of this invention still more effective. The absolute magnitude of make [the record number of partitions / many] of the ink which will apply much more deliveries to one picture field, and is driven in in this picture field by 1 time of the writing scan also decreases. Therefore, while a picture can be smoothed more, the effect of the irregular color depended for oozing out and shade unevenness HE which have so far been explained is also expectable.

[0238] Drawing 41 is drawing for ink suction operation of the ink-jet recording device which applied this invention being shown, and is the cross section showing typically the cap portion shown in drawing 18 .

[0239] In drawing 41 , the porous ink absorber 20 is formed in the interior of each capping 17. As shown in drawing 41 (A), this ink absorber 20 is arranged so that it may be located near the delivery forming face 21 at the time of capping. In addition, the high-density slash portion 30 in drawing 41 shows the ink (drawn in) sucked out of the delivery.

[0240] Drawing 41 (A) sticks a cap 117 to the delivery side 21, operates a suction pump, and after it attracts ink from each delivery by generating negative pressure in a cap 17 through a tube 27, it shows the state when stopping operation of a suction pump. In this state, the negative pressure in a suction pump is almost canceled by attracting the ink of a certain amount. That is, negative pressure is decreasing to the grade which the meniscus of each delivery does not make destroy. If a cap 117 is pulled apart from the delivery side 21 while negative pressure has been in a strong state, atmospheric pressure takes in an instant in a cap 15, the meniscus in

a delivery is torn by this rapid pressure fluctuation, air enters in a delivery, and the poor regurgitation may be started.

[0241] Moreover, as shown in drawing 43, the force which makes ink the method of sucking with the adhesion force of ink or the negative pressure in a delivery in the interface of a delivery forming face and ink acts. In order that the surface tension which ink itself tends to condense may furthermore act on the ink in a cap 103, As it is narrow between ink 104, 105 arises and a cap separates the cross section of each vena-contracta 105 portion of ink 104 — small — becoming — there — most — weak — becoming — just — being alike — the relation between ink goes out in the portion of each vena contracta 105, and an ink drop may remain on a delivery forming face

[0242] In the state of drawing 41 (A), most inside of a cap 117 is full of ink, and is in the state where the ink absorber 20 is also saturated and there is almost no absorptance. If a cap is pulled apart in the state with this, a case of drawing 43 mentioned above and a result by which a lot of ink remains in the delivery forming face 21 similarly will be brought. Then, in this example, a crevice 31 is produced between a cap 117 and a delivery by carrying out very small movement of the carriage rightward in drawing. The very small movement magnitude of the carriage at this time is set as the suitable amount beyond the range in which sealing with a cap 117 is possible.

[0243] Drawing 42 is the **-type-view showing the state of the above-mentioned very small movement of carriage, drawing 42 (A) shows the state before movement, and drawing 42 (B) shows the state after movement. Moreover, drawing 41 (B) shows the state inside the cap immediately after carrying out the above-mentioned very small movement of the carriage from the state of drawing 41 (A). As shown in drawing 41 (B) and drawing 42 (B), a suction pump is operated again in the place which produced the crevice 31. The state inside the cap at this time is shown in drawing 41 (C). That is, if it changes into the state of drawing 41 (B) and a suction pump is operated again, since the cap is in the leak (opening) state, as shown in drawing 41 (C), only the ink in a cap 15 is attracted through a tube 27, and the ink absorber 20 of the porosity established in the cap 117 is recovered in the state in which ink absorption is possible again. Moreover, in the state of drawing 41 (C), since the porous ink absorber 20 is close to the delivery side 21, almost all the ink on the delivery forming face 21 is absorbed by the ink absorber 20. In this way, the ink absorbed by the ink absorber 20 is also attracted through a tube 27.

[0244] And at this time, carriage is returned to the position of the original position (A), i.e., drawing 41, and drawing 42 (A) once again, and ink absorptivity ability is changed into the state where the fully recovered ink absorber 20 approaches to all the fields of the delivery forming face 21. By carrying out like this, the ink remainder on the delivery forming face 21 can be decreased further.

[0245] Since the ink remainder on a delivery forming face decreases, color mixture generating can be prevented by recovery action.

[0246] Since a crevice 31 was produced, although carriage was moved to main scanning direction in the above-mentioned example, you may make it move in the direction of vertical scanning. furthermore, not carriage but a cap side is moved aslant etc. the upper and lower sides, right and left, and approximately — you may constitute

[0247] By the above, the ink remainder on a delivery forming face can be lost, without preparing an air open valve.

[0248] Drawing 44 is the typical cross section of the cap portion for other examples of suction operation being shown.

[0249] In drawing 44, the porous ink absorber 52 is formed in the interior of each cap 117. The capacity of this ink absorber 52 is set as the larger value than the amount of suction of a suction pump (the amount of forced discharges of the ink by 1 operation), or the larger value than the content volume of the ink passage of an ink-jet unit. And as shown in drawing 44 (A), the above-mentioned ink absorber 52 is arranged so that it may be located near the delivery forming face 81 at the time of capping. In addition, the slash portion 53 in drawing 44 shows the ink (drawn in) sucked out of the delivery.

[0250] Drawing 44 (A) sticks a cap 117 to the delivery forming face 81, operates a suction pump,

and shows the state where ink 52 is attracted from each delivery, by generating negative pressure in a cap 117 through a tube 19. Then, to predetermined timing, as shown in drawing 44 (B), a recording head and a cap 117 are separated and a crevice 54 is formed between them. Even if it is in the time of the negative pressure in a suction pump almost being canceled by stopping operation of a suction pump and attracting the ink of the specified quantity as timing which separates this recording head and cap 117, or the state where negative pressure is acting in a cap 117, the time of attracting the ink of the specified quantity etc. is selected. In addition, the ink attracted by the suction pump from a recording head is sent out through a tube or ink passage to a non-illustrated waste ink tank. This waste ink tank may constitute waste ink from an ink absorber of the porosity which carries out absorption maintenance.

[0251] In drawing 44 , the capacity of the porous ink absorber 52 is set as the larger value than the amount of suction of a suction pump (the amount of forced discharges of the ink by 1 operation), or the larger value than the content volume of the ink passage of a recording head like the above-mentioned. Therefore, it has to this ink absorber 52 side with the suction force of the ink absorber 52, and the ink 53 between the delivery forming face 81 and a cap 117 goes, as shown in drawing 44 (C). Consequently, as shown in drawing 44 (D), suction recovery action can be ended in the state where it does not leave ink to the delivery forming face 81 of a recording head. In this way, since suction recovery action is completed in the state where ink does not remain in the delivery forming face 81, the color mixture of unique ink can be prevented.

[0252] Moreover, by being filled up with the porous ink absorber 52 in a cap, directivity (direction which goes to a suction pump side from the delivery side 81) can be given to the ink flow in the cap 117 at the time of suction, and it enables the unique ink adhering to the delivery forming face 81 to prevent the color mixture of invading in a delivery.

[0253] (in addition to this) In addition, especially this invention is equipped with meanses (for example, an electric thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used also in an ink-jet recording method in order to make ink **** perform, and brings about the effect which was excellent in the recording head of the method which makes the change of state of ink occur with the aforementioned heat energy, and the recording device. It is because the densification of record and highly minute-ization can be attained according to this method.

[0254] About the typical composition and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 specification and the 4740796 specification, for example is desirable. Although this method is applicable to both the so-called on-demand type and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the on-demand type case By impressing at least one driving signal which gives the rapid temperature rise which corresponds to recording information and exceeds nucleate boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the air bubbles in the liquid (ink) corresponding to this driving signal can be formed by the one to one as a result, it is effective. A liquid (ink) is made to breathe out through ***** opening by growth of these air bubbles, and contraction, and at least one drop is formed. If this driving signal is made into the shape of a pulse form, since growth contraction of air bubbles will be performed appropriately instancy, **** of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable. As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed.

[0255] The composition using the U.S. Pat. No. 4558333 specification and U.S. Pat. No. 4459600 specification which indicate the composition arranged to a delivery which is indicated by each above-mentioned specification as composition of a recording head, the liquid route, and the field to which the heat operation section other than the combination composition (a straight-line-like liquid flow channel or right-angled liquid flow channel) of an electric thermal-conversion object is

crooked is also included in this invention. In addition, the effect of this invention is effective also as composition based on JP,59-138461,A which indicates the composition whose puncturing which absorbs the pressure wave of JP,59-123670,A which indicates the composition which makes a common slit ***** of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to *****. That is, it is because it can record efficiently certainly according to this invention no matter the form of a recording head may be what thing.

[0256] In addition, this invention is effective when the thing of a serial type like an upper example also uses the recording head fixed to the main part of equipment, the recording head exchangeable chip type to which the electric connection with the main part of equipment and supply of the ink from the main part of equipment are attained by the main part of equipment being equipped, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one.

[0257] Moreover, it is a book as composition of the recording device of this invention to add the regurgitation recovery means of a recording head, preliminary auxiliary means, etc. If these are mentioned concretely, a preheating means to heat using the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over-a-recording head, and a reserve regurgitation means to perform the regurgitation different from record can be mentioned.

[0258] moreover, two or more ink which differs in an others and record color or concentration although only one piece was prepared also about the kind or the number of a recording head carried, for example corresponding to monochromatic ink — corresponding — two or more pieces — more than — it may be prepared That is, although not only the recording mode of only mainstream colors, such as black, but a recording head may be constituted in one as a recording mode of a recording device or the paddle gap by two or more combination is sufficient, for example, this invention is very effective also in equipment equipped with at least one of each of the full color recording mode by the double color color of a different color, or color mixture.

[0259] Furthermore, in addition, in this invention example explained above, although ink is explained as a liquid It is ink solidified less than [a room temperature or it], and what is softened or liquefied at a room temperature may be used. Or by the ink-jet method, since what carries out a temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stable regurgitation range about the viscosity of ink, ink may use what makes the shape of liquid at the time of use record signal grant. In addition, in order to prevent the temperature up by heat energy positively because you make it use it as energy of the change of state from a solid state to the liquid state of ink, or in order to prevent evaporation of ink, you may use the ink which solidifies in the state of neglect and is liquefied by heating. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied when using the ink of the property liquefied for the first time by grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when reaching a record medium. The ink in such a case is good for a porosity sheet crevice or a breakthrough which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the state where it was held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0260] Furthermore, in addition, as a form of this invention ink-jet recording device, although used as the picture outgoing end end of information management systems, such as a computer, you may take the form of the reproducing unit combined with others, the reader, etc., and the facsimile apparatus which has a transceiver function further.

[Translation done.]

* NOTICES *

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the perspective diagram showing the important section composition of the color ink-jet recording device using conventional shade ink.

[Drawing 2] It is explanatory drawing for explaining generating of concentration unevenness.

[Drawing 3] It is explanatory drawing for explaining generating of concentration unevenness.

[Drawing 4] It is explanatory drawing for explaining relief of concentration unevenness.

[Drawing 5] It is the ** type view showing the delivery arrangement for explaining the division recording method, and the record dot arrangement by it.

[Drawing 6] It is explanatory drawing for explaining the cause of irregular color generating in a record picture.

[Drawing 7] It is the typical front view of the recording head of the conventional example.

[Drawing 8] It is the block diagram showing the control composition of the color ink-jet recording device in the example 1 of this invention.

[Drawing 9] It is the block diagram showing an example of the picture signal processing circuit shown in drawing 8 .

[Drawing 10] It is the ** type view of the shade distribution table shown in drawing 8 .

[Drawing 11] It is the perspective diagram showing the important section composition of the color ink-jet recording device in one example of this invention.

[Drawing 12] It is the decomposition perspective diagram showing the composition of the ink-jet unit in one example of this invention.

[Drawing 13] It is the perspective diagram showing the fluting top plate which constitutes the above-mentioned ink-jet unit.

[Drawing 14] It is the ** type view showing the ink delivery array of the ink-jet unit concerning the example of this invention.

[Drawing 15] It is explanatory drawing showing the image formation process at the time of using the ink-jet unit of the delivery array shown in drawing 14 (A).

[Drawing 16] It is explanatory drawing showing the image formation process at the time of using the ink-jet unit of the ink delivery array shown in drawing 14 (B).

[Drawing 17] It is explanatory drawing showing the image formation process at the time of using the ink-jet unit of the ink delivery array shown in drawing 14 (C).

[Drawing 18] It is the perspective diagram showing the important section composition of the color ink-jet recording device in other examples of this invention.

[Drawing 19] It is the decomposition perspective diagram showing the composition of the ink-jet unit in an example besides the above.

[Drawing 20] It is the perspective diagram showing the fluting top plate of the ink-jet unit concerning an example besides the above.

[Drawing 21] It is the ** type view showing the ink-jet unit which has a delivery train for the object for dark ink, and light ink in the same ink-jet unit about an example besides the above.

[Drawing 22] It is the ** type view showing the ink-jet unit which has a delivery train for the object for dark ink, the object for inside concentration ink, and light ink in the same ink-jet unit about an example besides the above.

[Drawing 23] It is the ** type view showing the ink-jet unit which has a delivery train for the object for dark ink, and light ink in the same ink-jet unit about an example besides the above.

[Drawing 24] It is the ** type view showing the ink-jet unit which has the delivery train from which the delivery train and ink discharge quantity for the object for dark ink and light ink differ in the same ink-jet unit about an example besides the above.

[Drawing 25] It is explanatory drawing showing the image formation process at the time of using the ink-jet unit of the ink delivery array shown in drawing 21 .

[Drawing 26] It is explanatory drawing showing the image formation process at the time of using the ink-jet unit of the ink delivery array shown in drawing 23 .

[Drawing 27] It is explanatory drawing showing the image formation process at the time of using the ink-jet unit of the ink delivery array shown in drawing 24 .

[Drawing 28] It is drawing showing the ink-jet unit which has an ink delivery train corresponding to the total ink color used for record in the same ink-jet unit about the example of further others of this invention.

[Drawing 29] It is the decomposition perspective diagram really finished setting up two or more ink-jet units in one showing the structure of an ink-jet cartridge about the example of this invention.

[Drawing 30] It is drawing showing the situation when carrying an one-apparatus ink-jet cartridge in carriage about the example of this invention.

[Drawing 31] It is explanatory drawing for explaining the record state by the example of further others of this invention.

[Drawing 32] It is the typical front view showing the recording head composition concerning the example 2 of this invention.

[Drawing 33] It is a ** type view for the ink dot at the time of performing division record oozing out, and explaining a state.

[Drawing 34] It is explanatory drawing for explaining a basing-on above-mentioned example 2 record state.

[Drawing 35] It is the typical front view of the recording head concerning the modification of the above-mentioned example 2.

[Drawing 36] It is the typical front view showing the recording head concerning the modification of the above-mentioned example 2.

[Drawing 37] It is explanatory drawing for explaining the record state by the modification shown in drawing 35 .

[Drawing 38] It is the typical front view showing the recording head concerning the modification of further others of the above-mentioned example 2.

[Drawing 39] It is explanatory drawing for explaining the record state by the recording head shown in drawing 37 .

[Drawing 40] It is explanatory drawing for explaining each color bond position in the record shown in drawing 38 .

[Drawing 41] It is explanatory drawing explaining cap secession operation in the example of this invention.

[Drawing 42] It is explanatory drawing explaining cap secession operation in the example of this invention.

[Drawing 43] It is explanatory drawing explaining cap secession operation concerning the conventional example.

[Drawing 44] It is explanatory drawing explaining other examples of the above-mentioned cap secession operation.

[Description of Notations]

1 Picture Input Section

2 Control Unit

3 CPU

4 ROM

4a I/O gamma correction table

4b Masking table

4c Black generation and a UCR table
4d Shade distribution table
4e Program group
5 RAM
6 Picture Signal Processing Section
7 Printer Section
8 Bus Line
11 Input Gamma Correction Circuit
12 Color-Correction (Masking) Circuit
13 Black Generation and UCR Circuit
14 Output Gamma Correction Circuit
15 Shade Distribution Circuit
16 Binary-ized Processing Circuit
40,110,240 Ink-jet unit
41,241 Carriage
42,242 Delivery roller
43,243 Guide shaft
44,244 Driving belt
45,245 Carriage motor
46,246 Recovery unit
47,117,247 Cap section
50 Wiring Substrate
51 Heater Board
52 Base Material
53 Pressure Spring
54 Fluting Top Plate
55 Ink Supply Pipe
56 Filter
57 Ink Feed-Zone Material
58 59 Hole for checking and verifying
60 Bridgewall
61 Ink Feed Hopper
62 Slot
220 Frame
221 Covering
222 Connector
223 Electrode
224 Ink-Jet Unit
230 Ink Cartridge
231 Contact

[Translation done.]

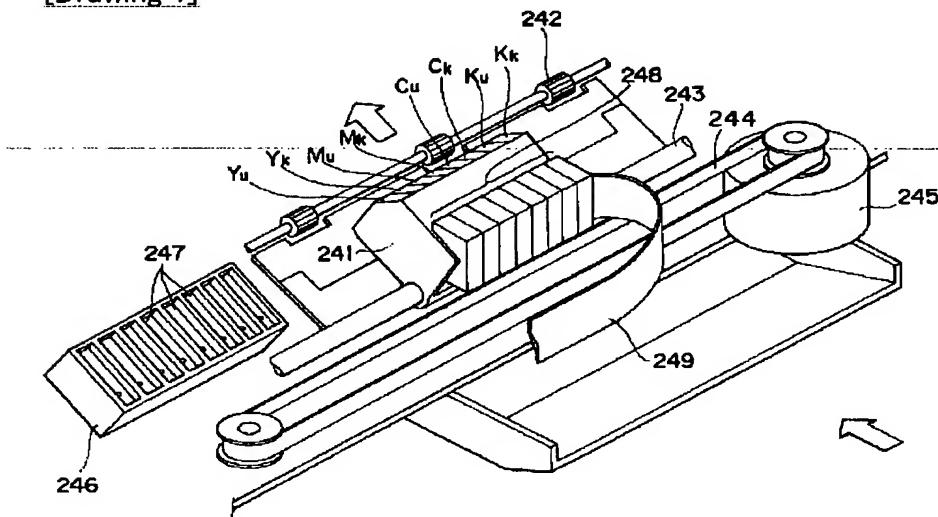
* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

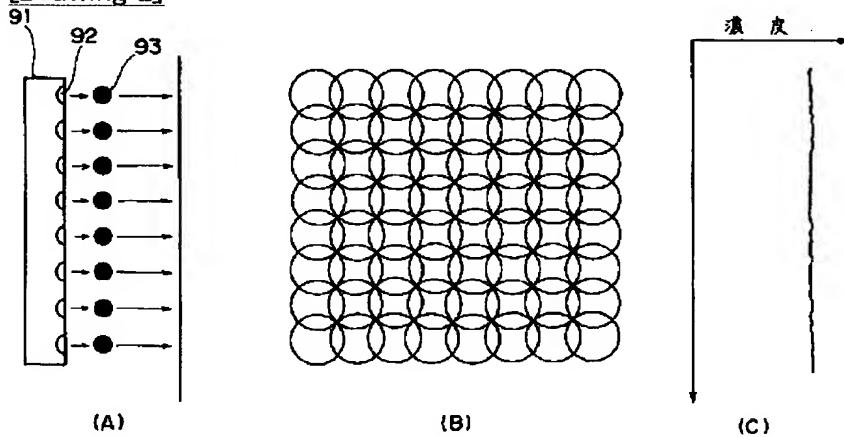
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. *** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

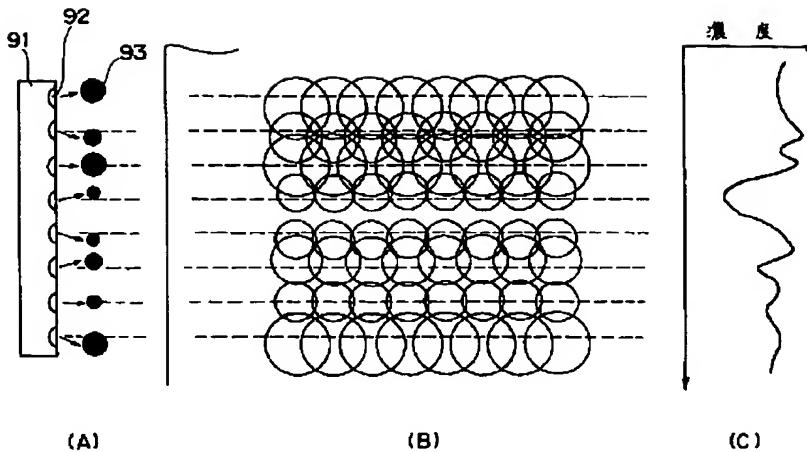
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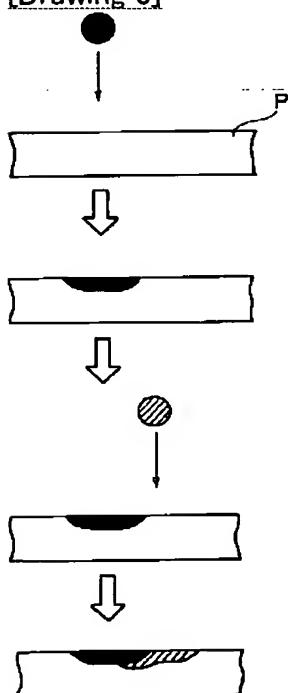
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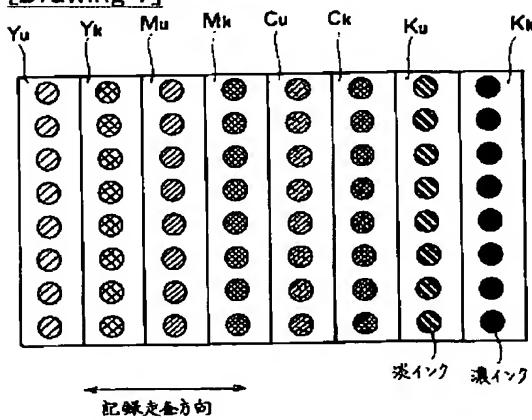
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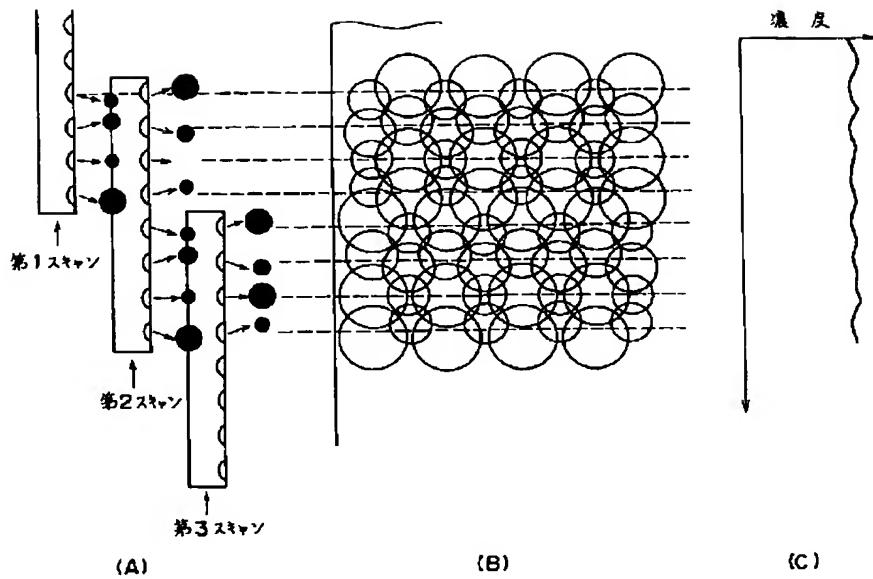
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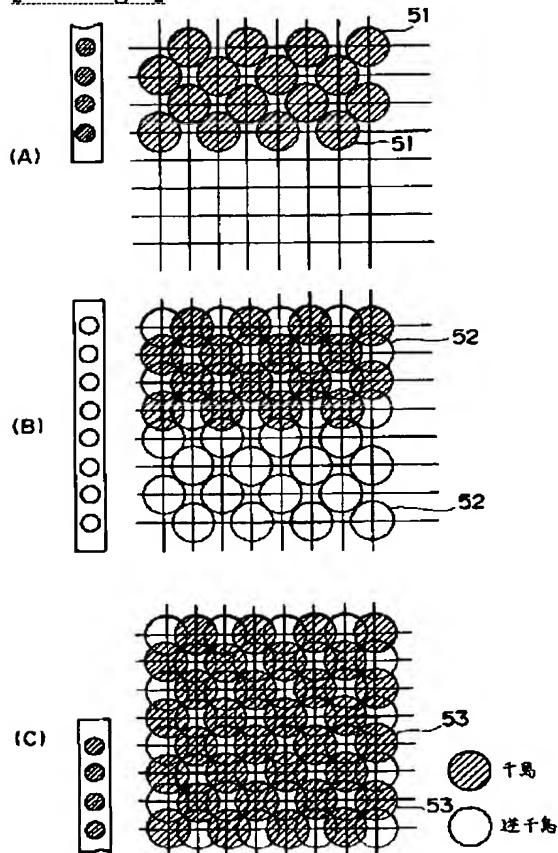
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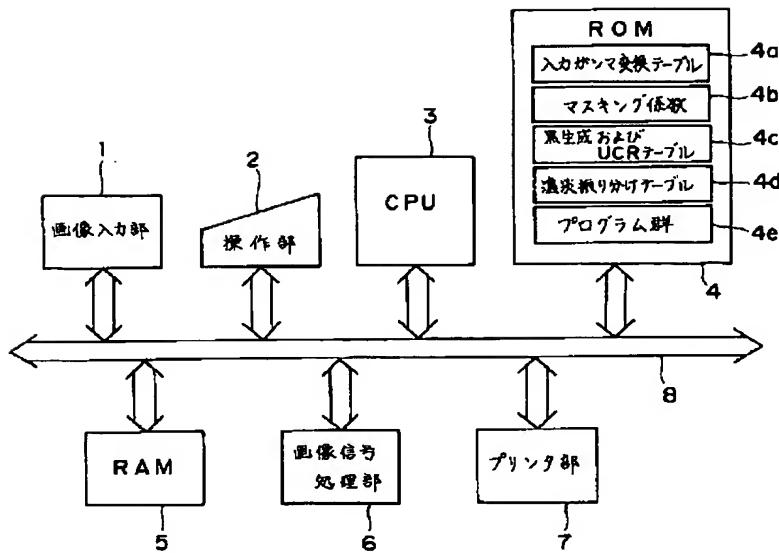
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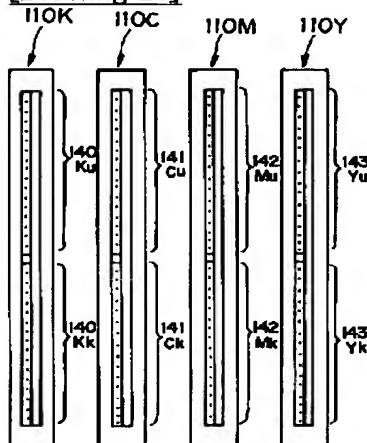
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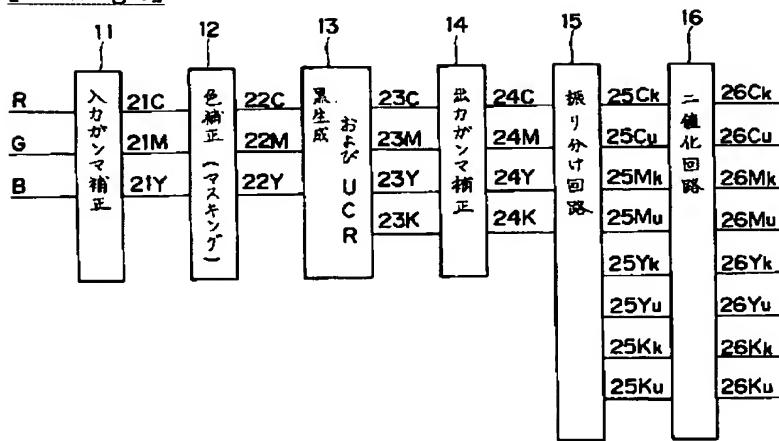
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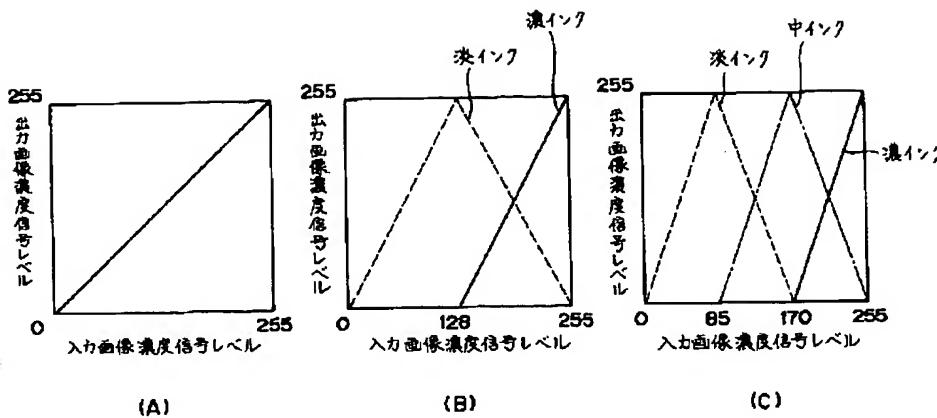
[Drawing 21]



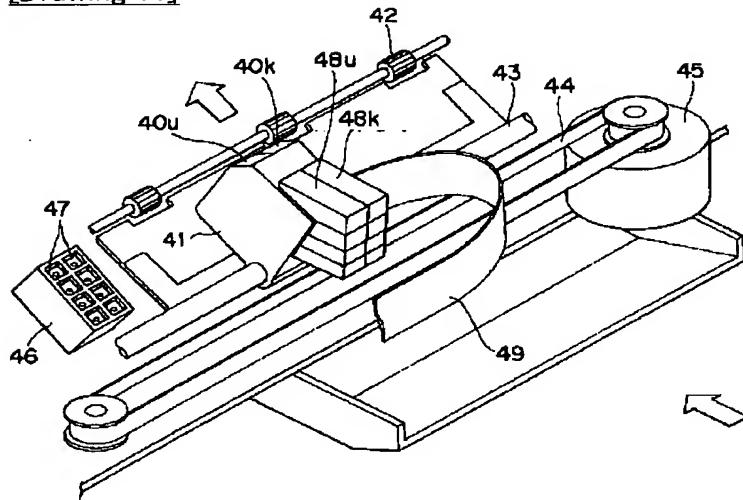
[Drawing 9]



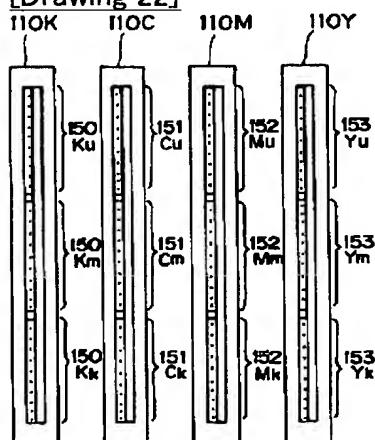
[Drawing 10]



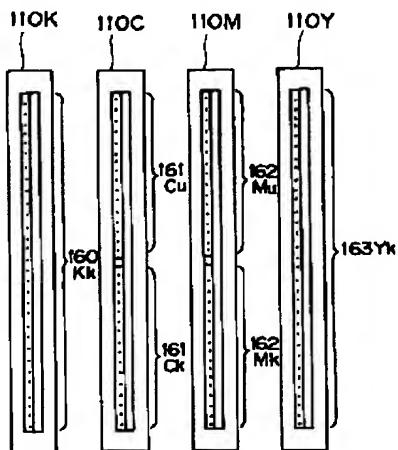
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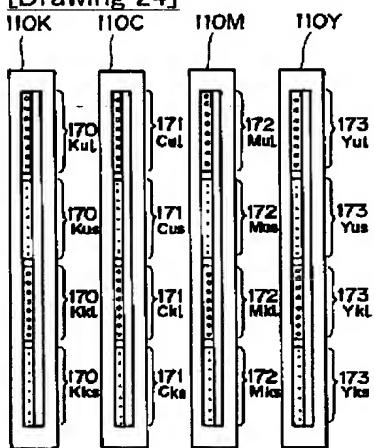
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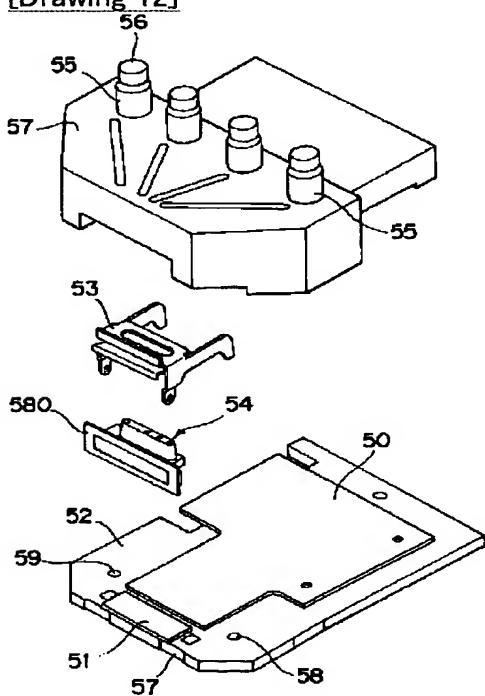
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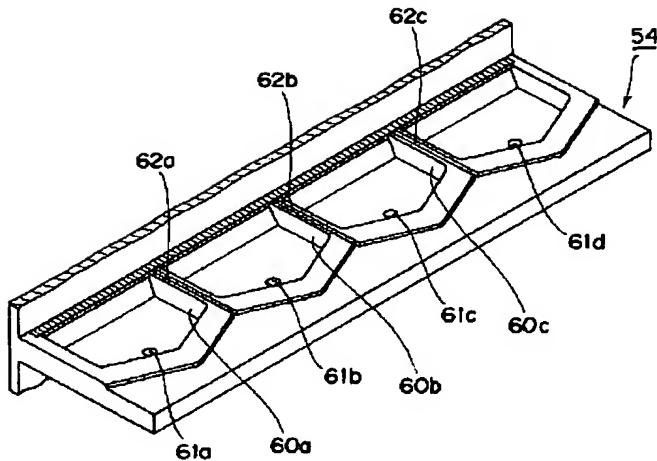
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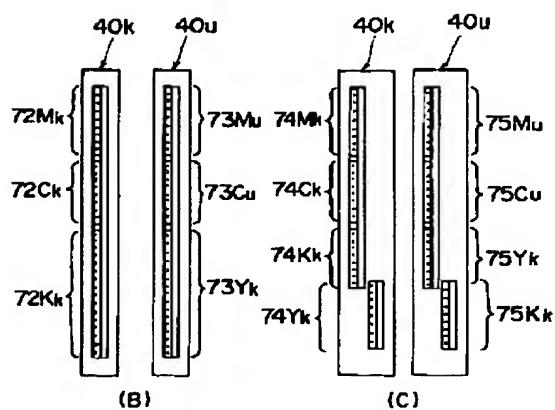
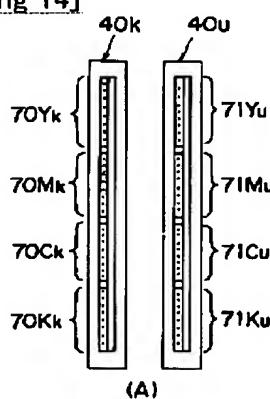
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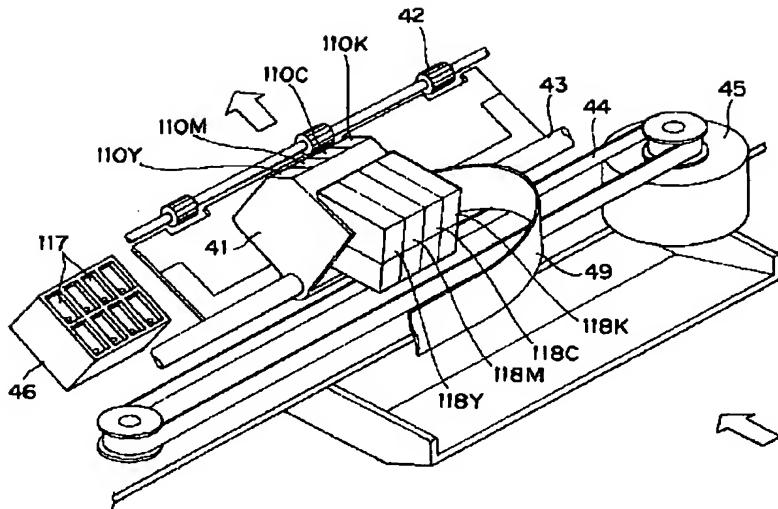
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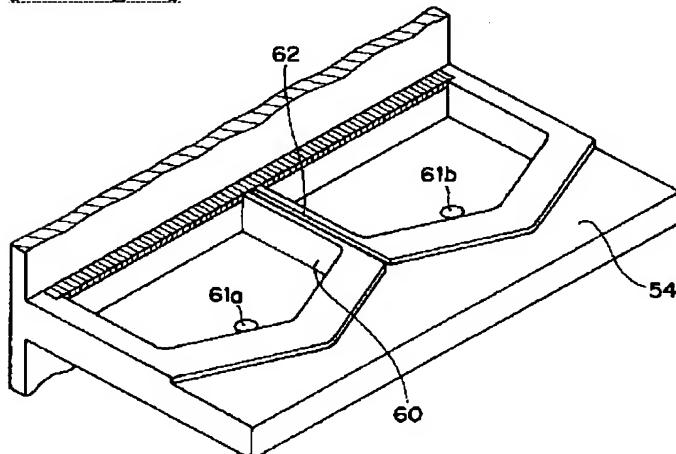
[Drawing 14]



[Drawing 18]

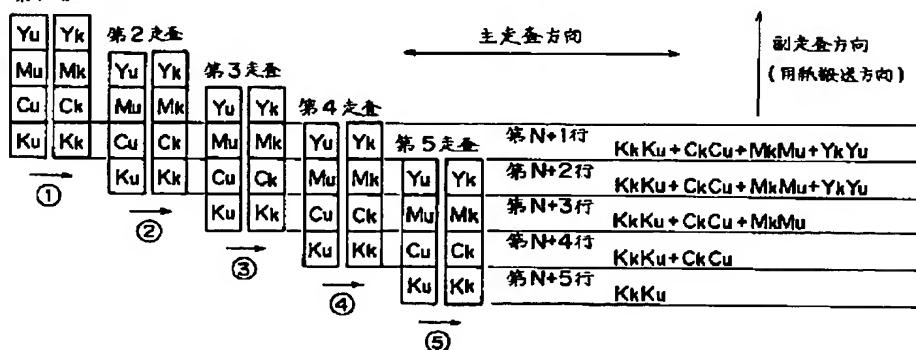


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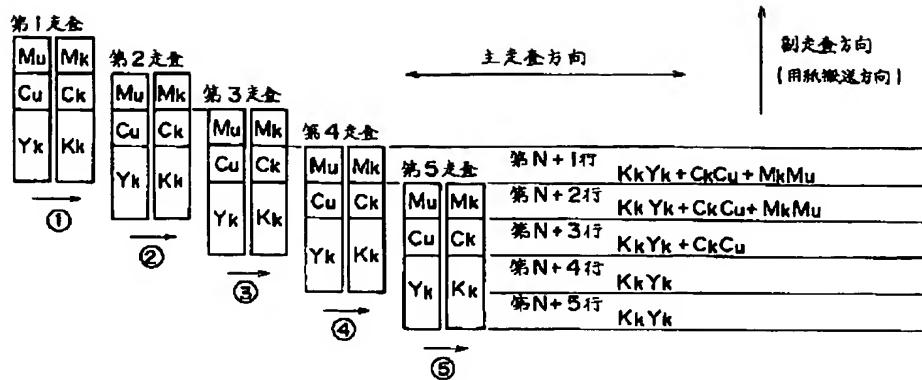


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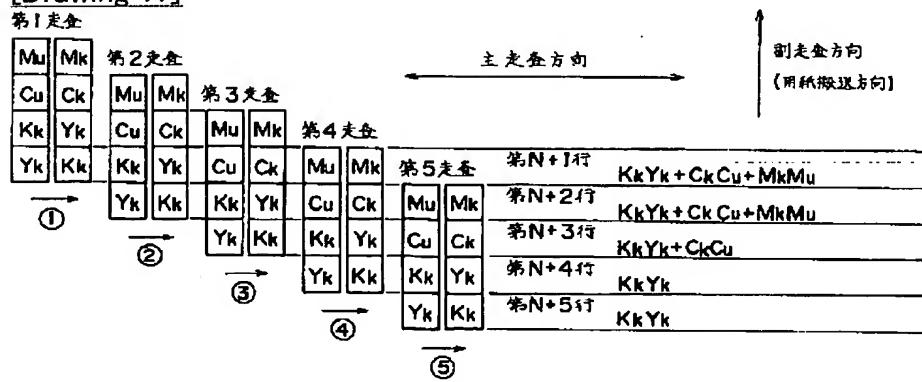
第1走査



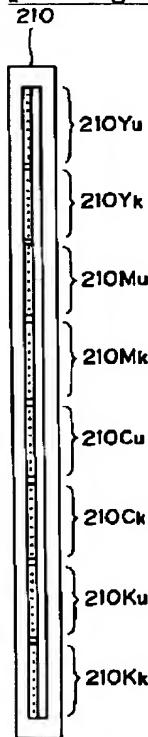
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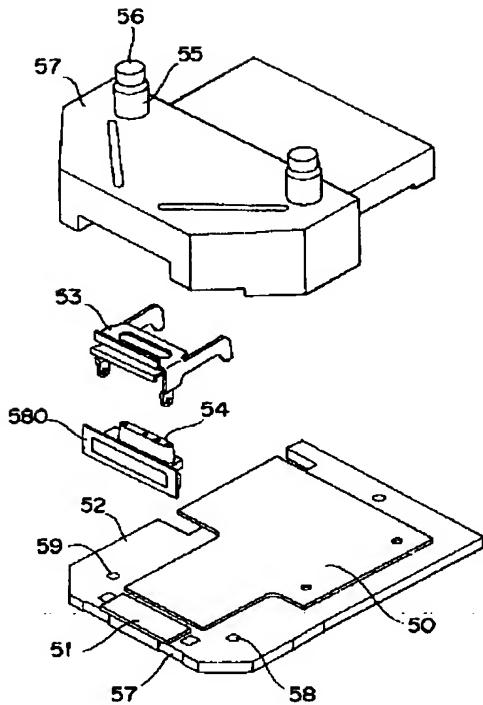
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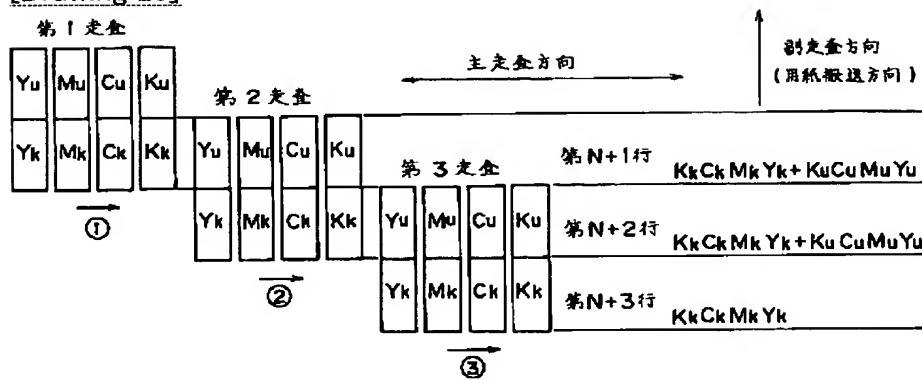
[Drawing 28]



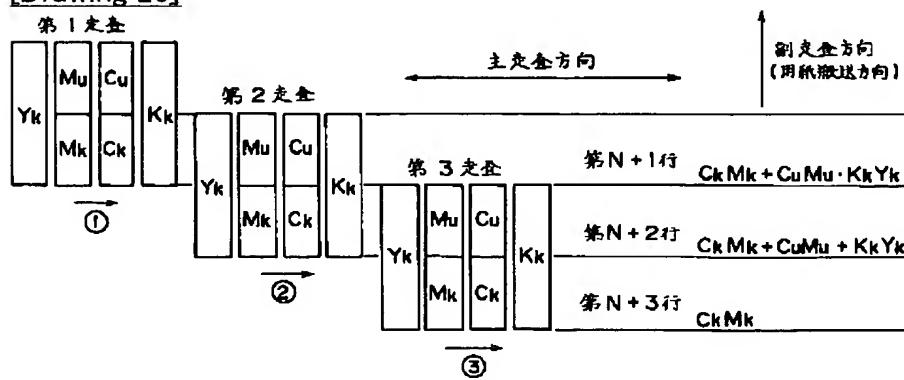
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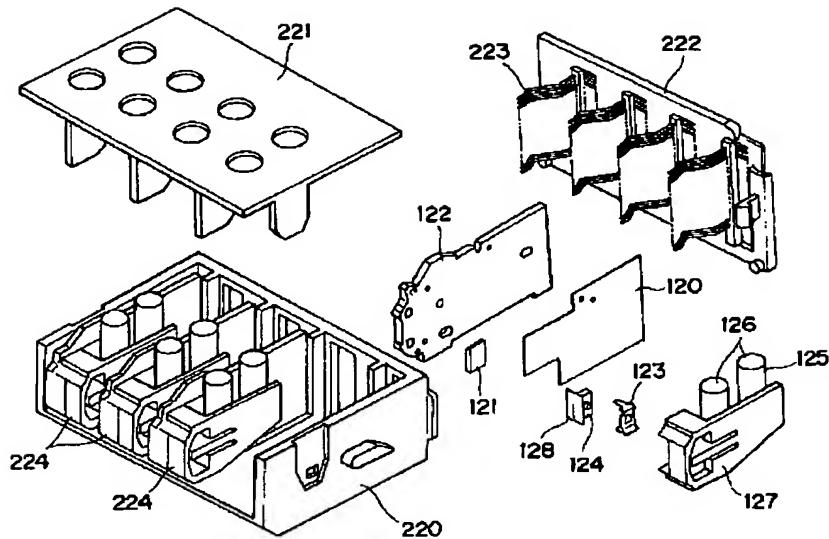
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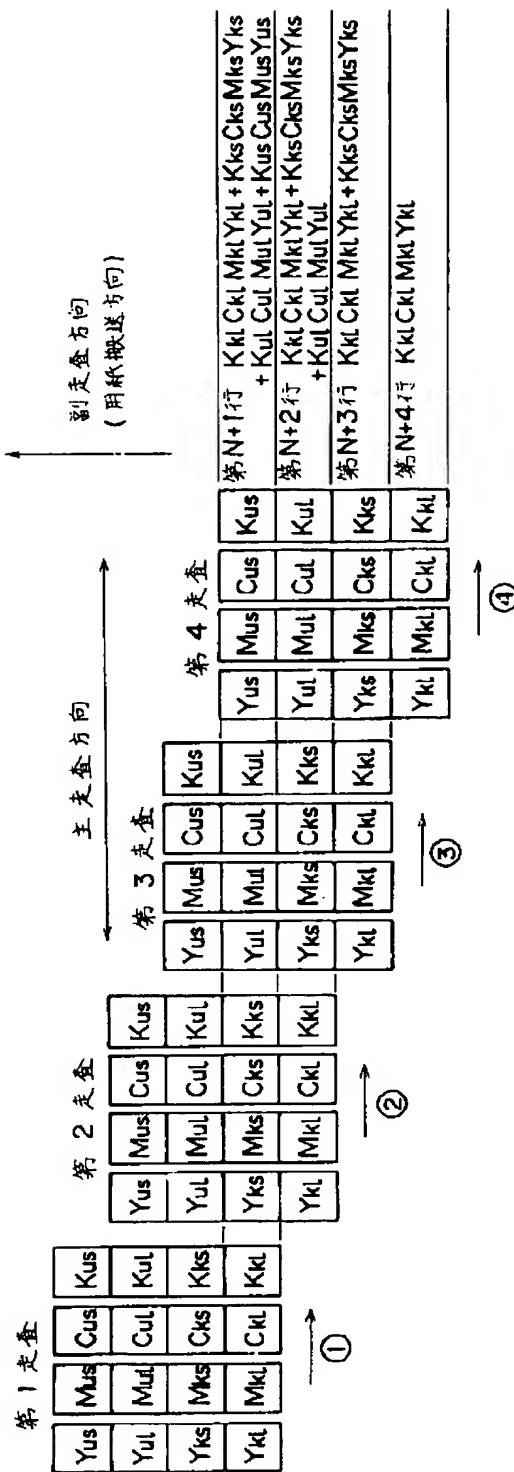
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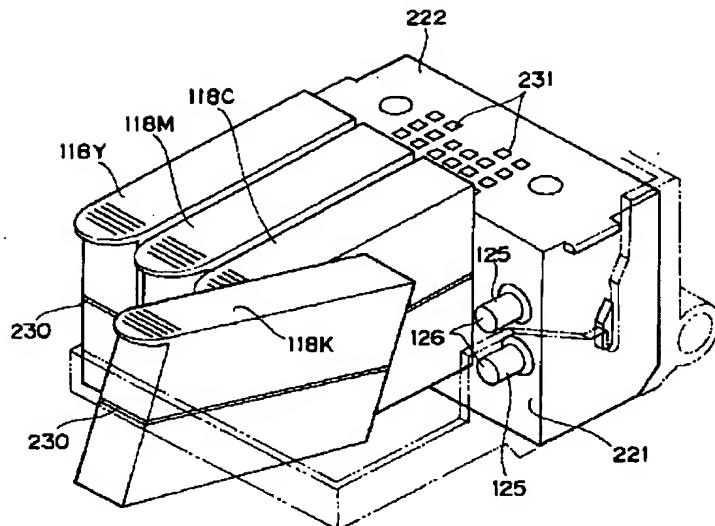
[Drawing 29]



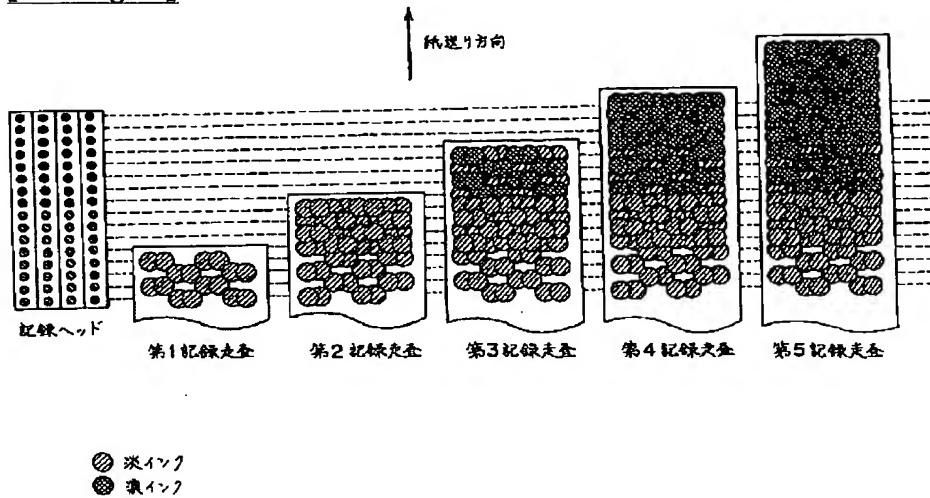
[Drawing 27]



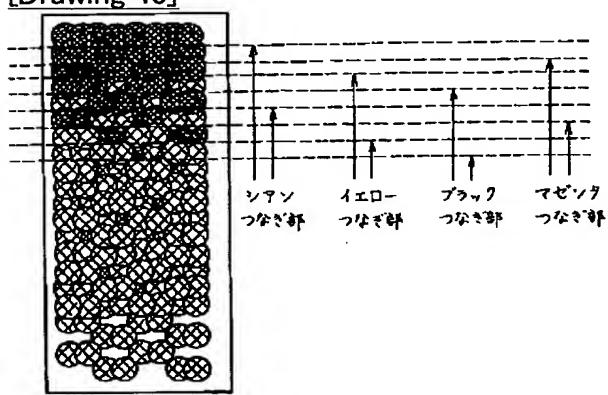
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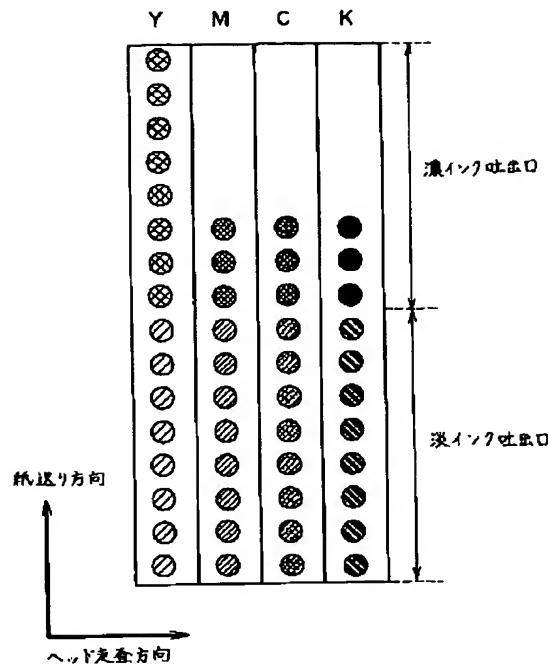
[Drawing 31]



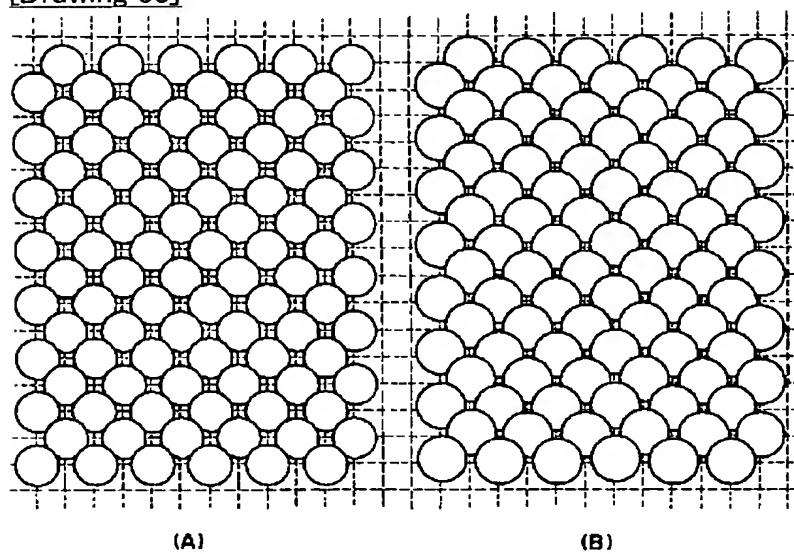
[Drawing 40]



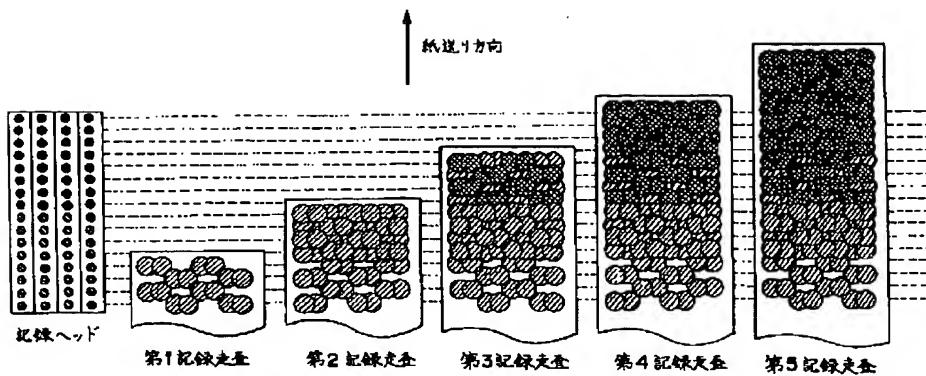
[Drawing 32]



[Drawing 33]

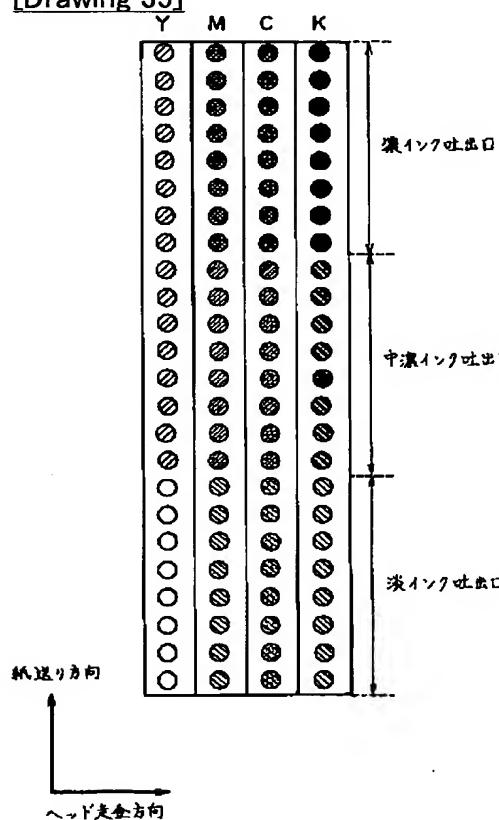


[Drawing 34]

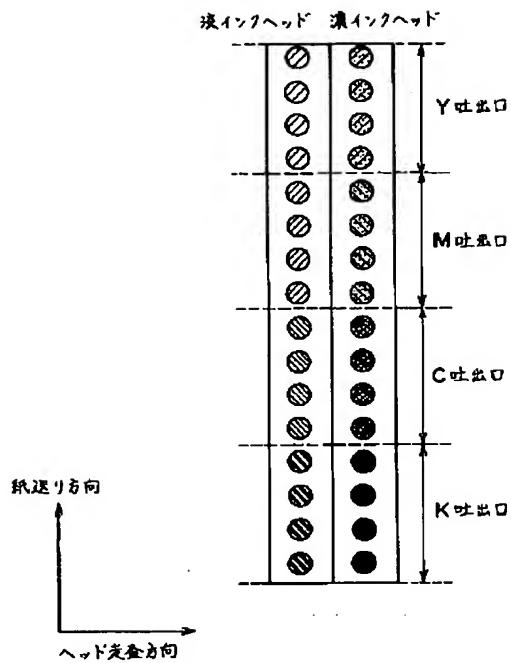


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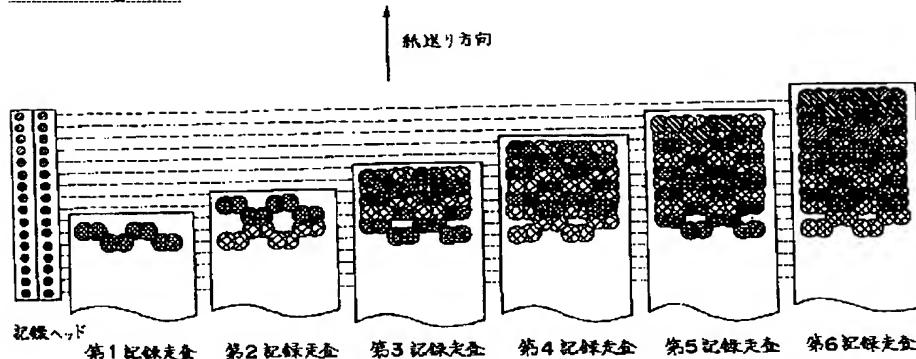
[Drawing 35]



[Drawing 36]

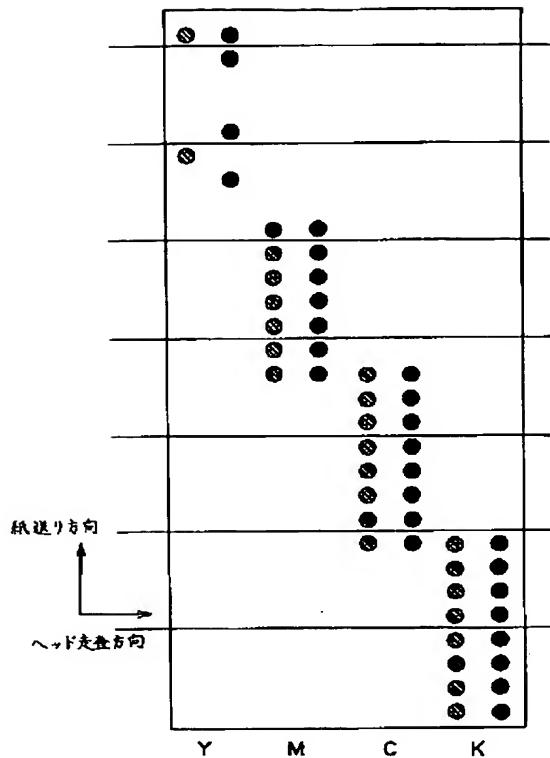


[Drawing 37]

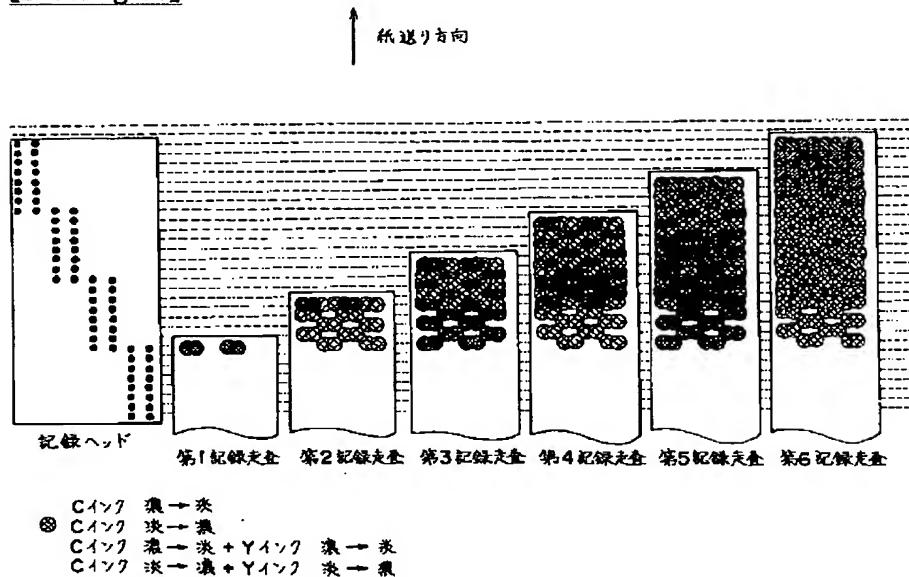


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[Drawing 38]

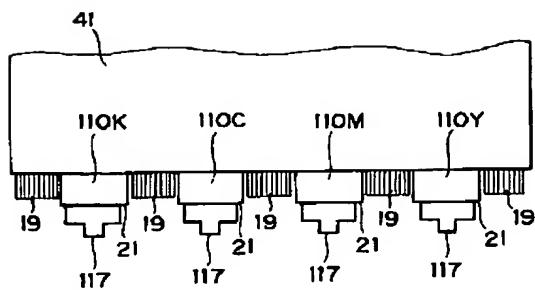


[Drawing 39]

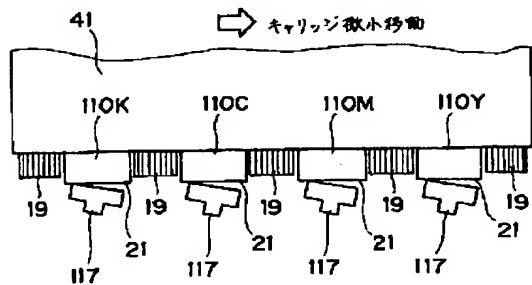


[Drawing 42]

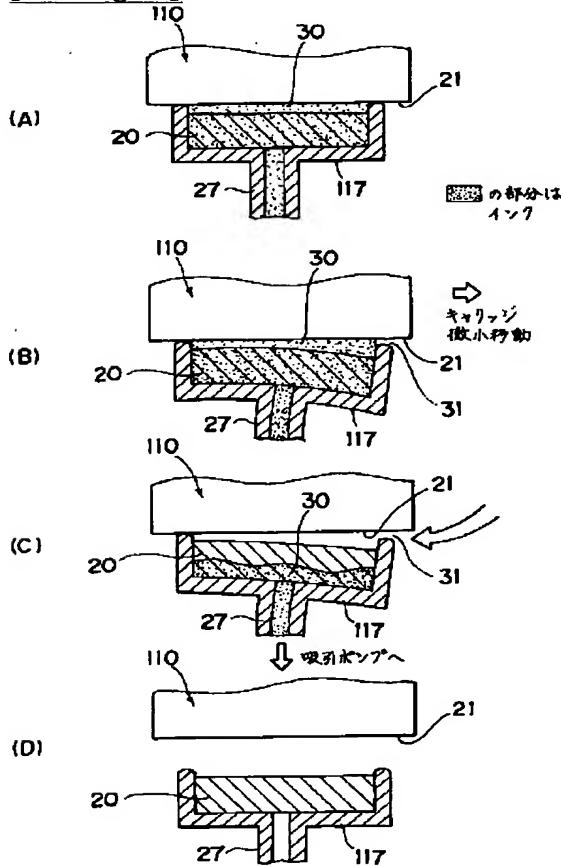
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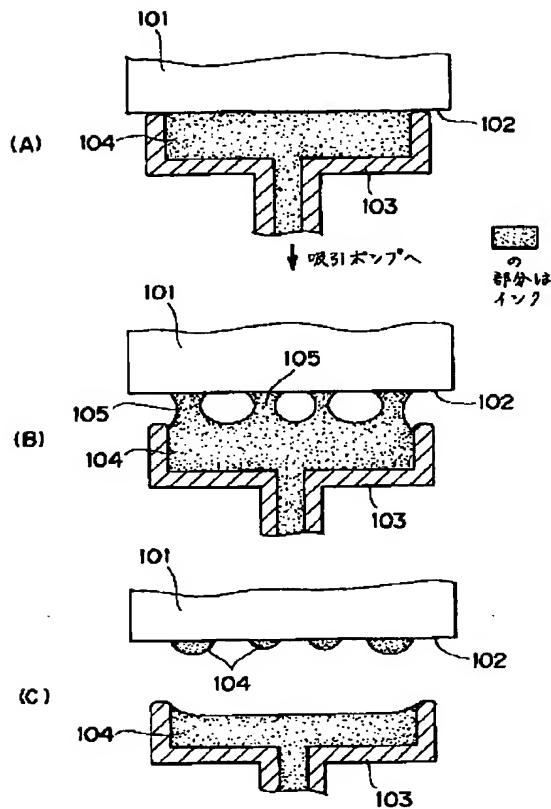
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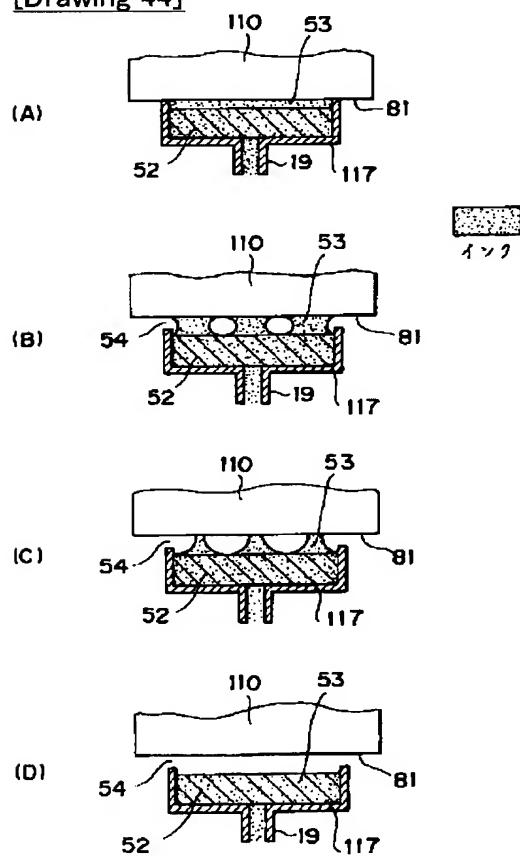
[Drawing 41]



[Drawing 43]

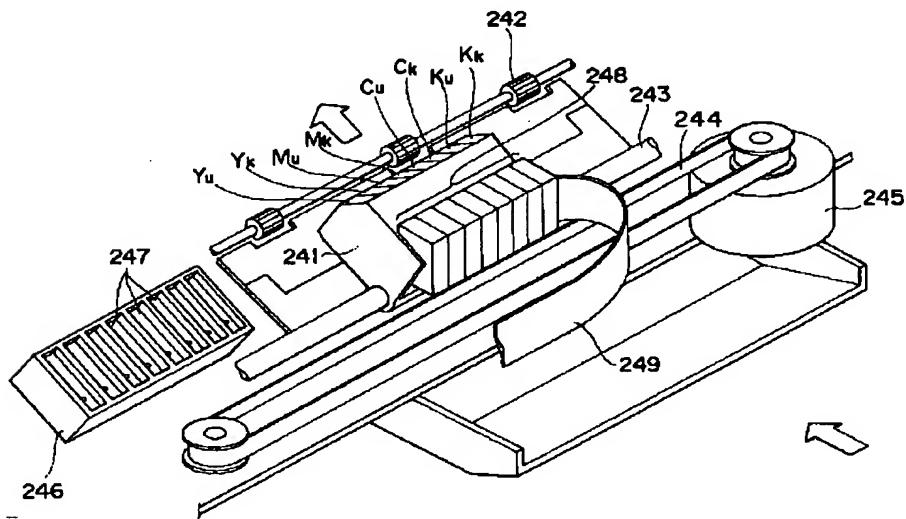


[Drawing 44]



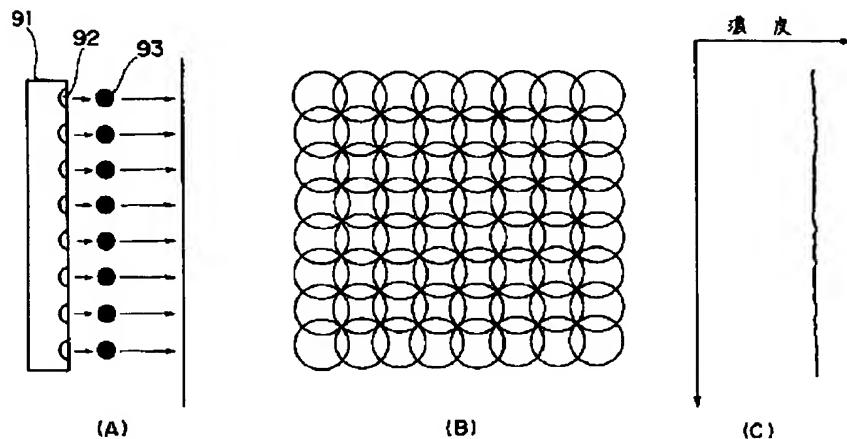
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Drawing selection drawing 1



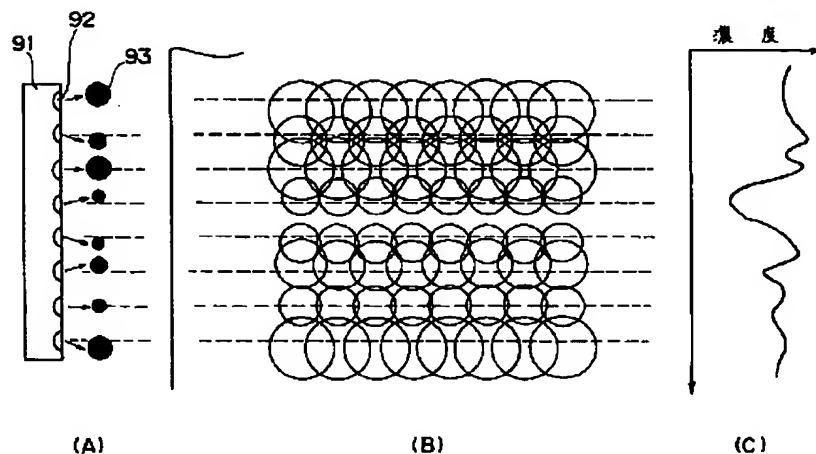
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Drawing selection drawing 2



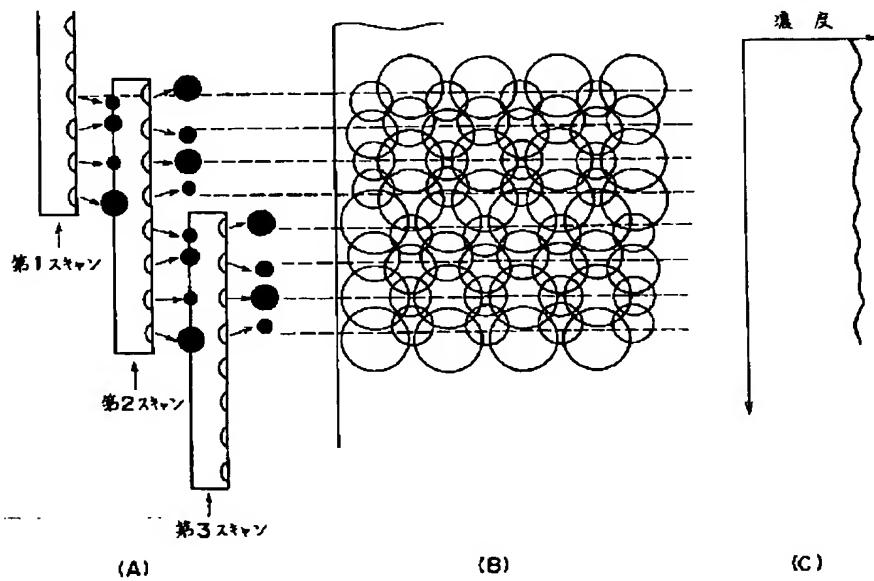
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Drawing selection drawing 3



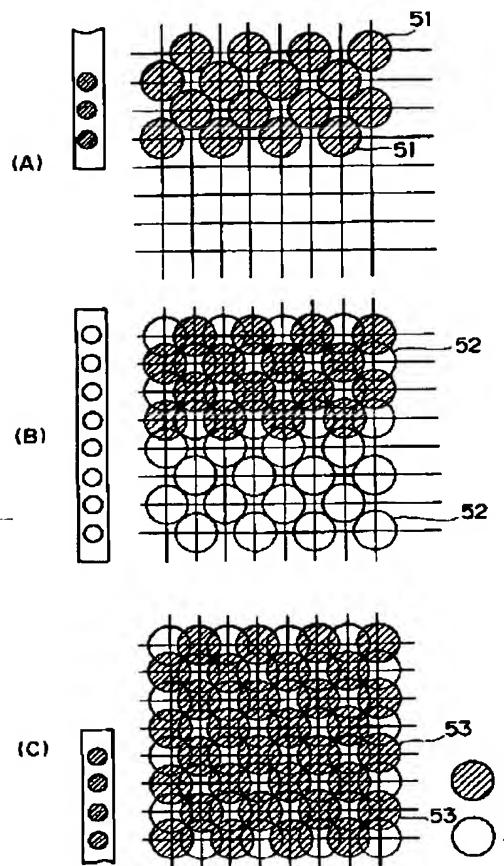
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Drawing selection drawing 4



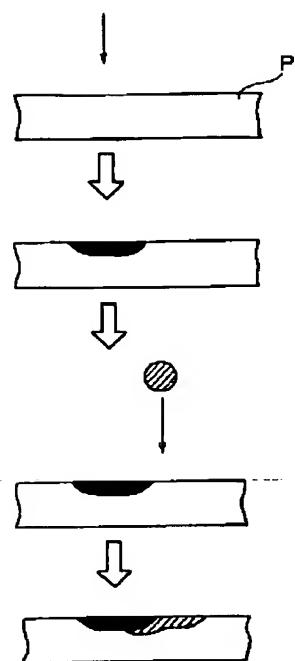
[Translation done.]

Drawing selection drawing 5



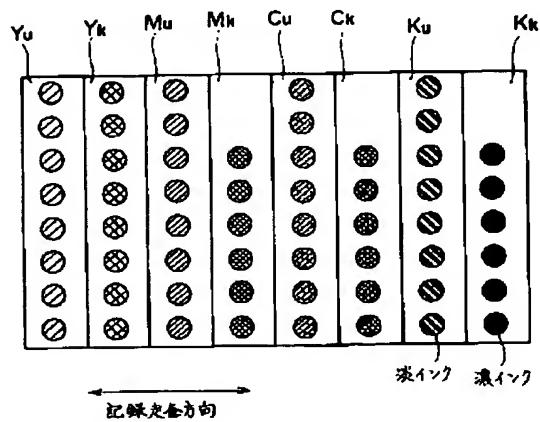
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Drawing selection drawing 6



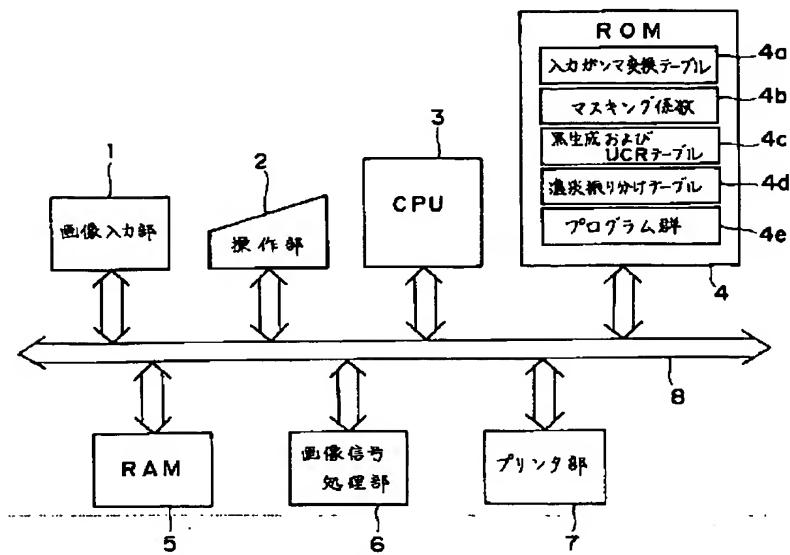
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Drawing selection drawing 7



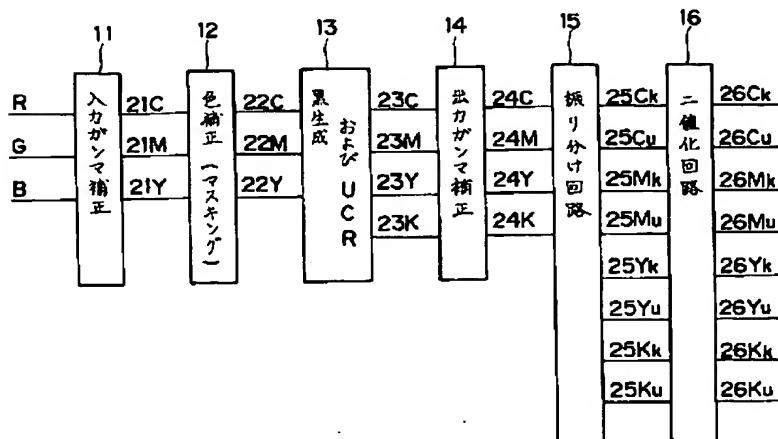
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Drawing selection drawing 8



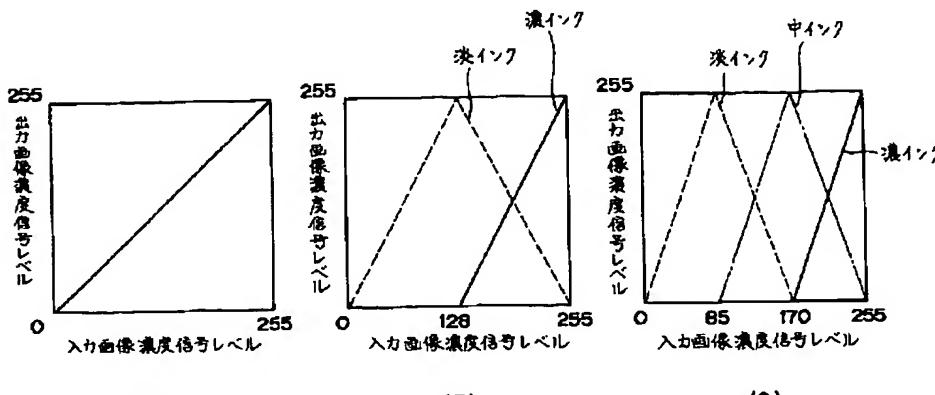
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Drawing selection drawing 9



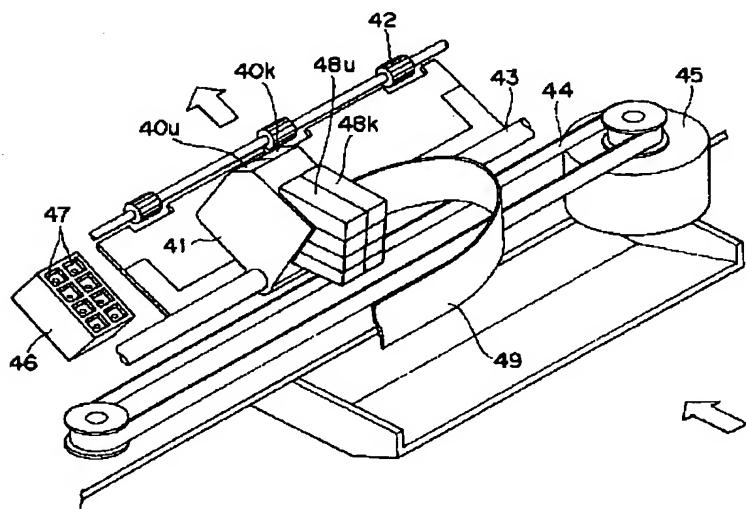
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Drawing selection drawing 10



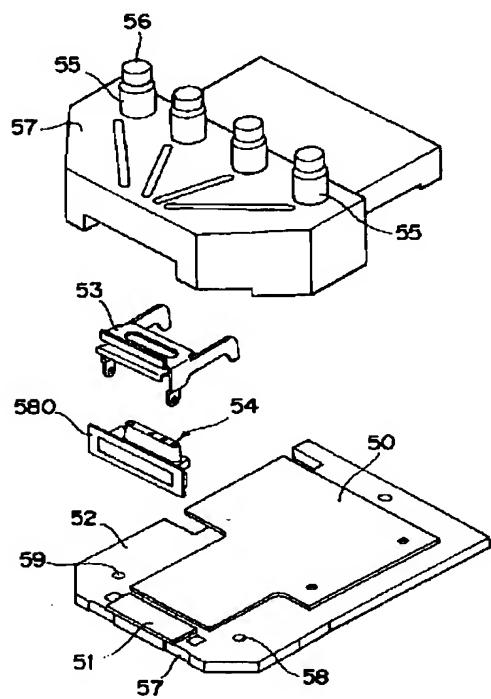
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Drawing selection drawing 11



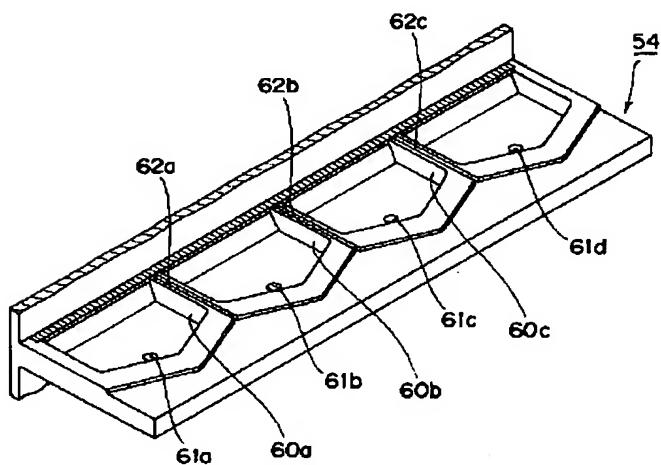
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Drawing selection drawing 12



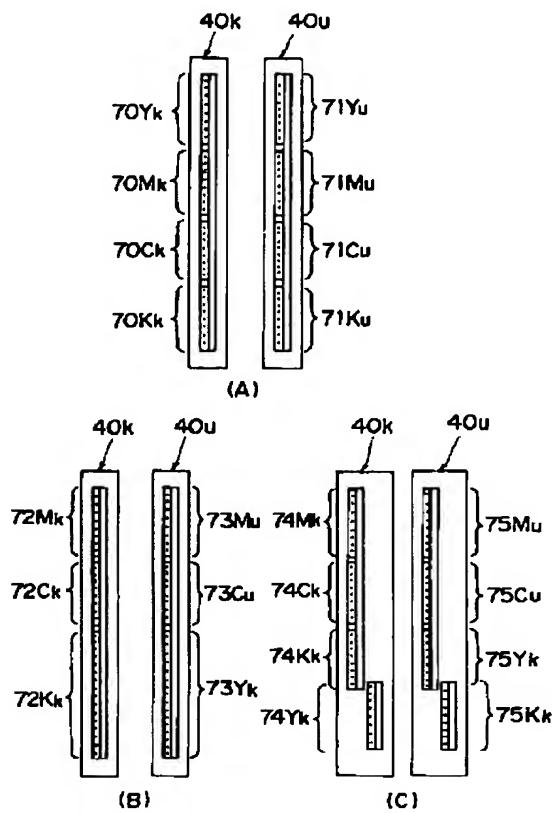
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Drawing selection drawing 13



[Translation done.]

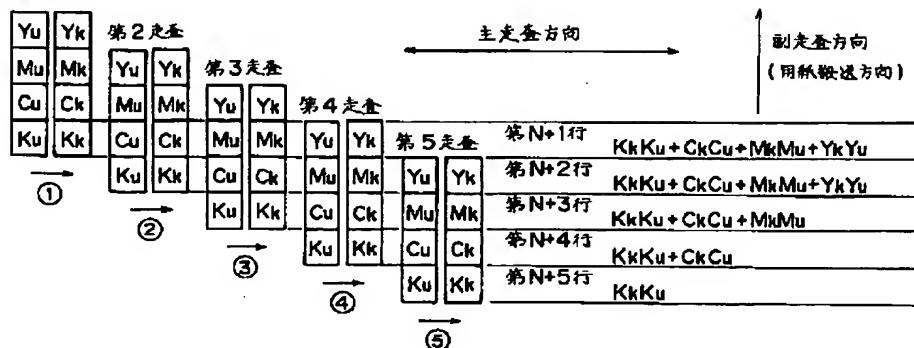
Drawing selection drawing 14



[Translation done.]

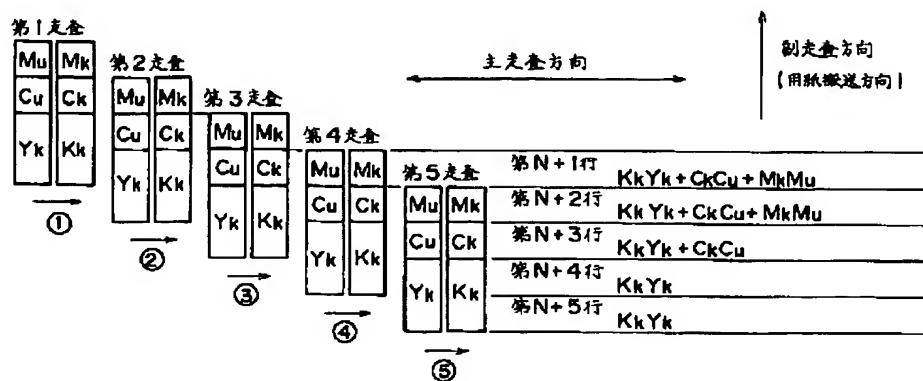
Drawing selection drawing 15

第1走査



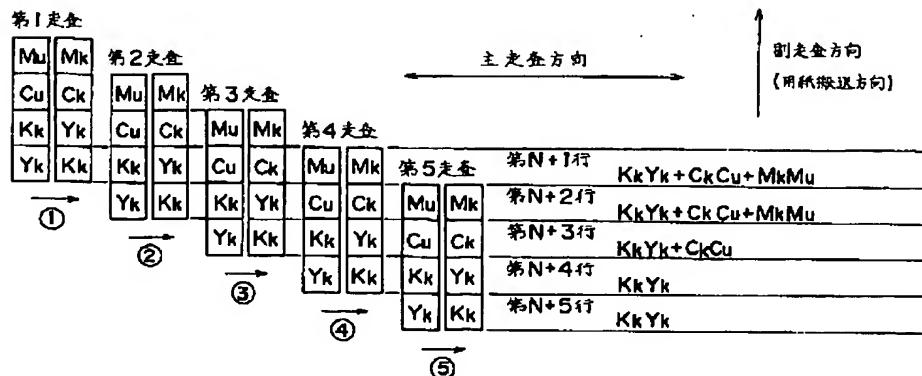
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Drawing selection drawing 16



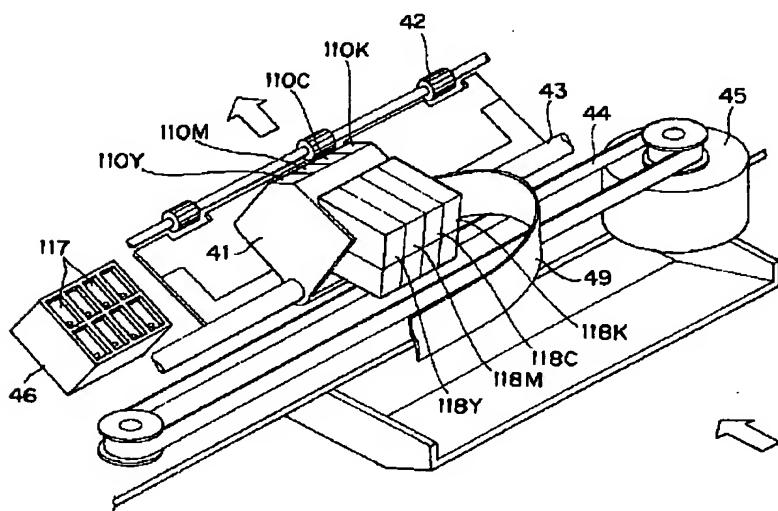
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Drawing selection drawing 17



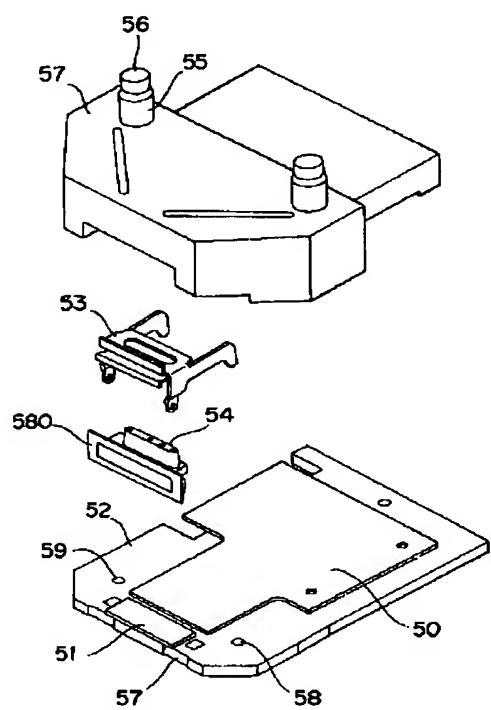
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Drawing selection drawing 18



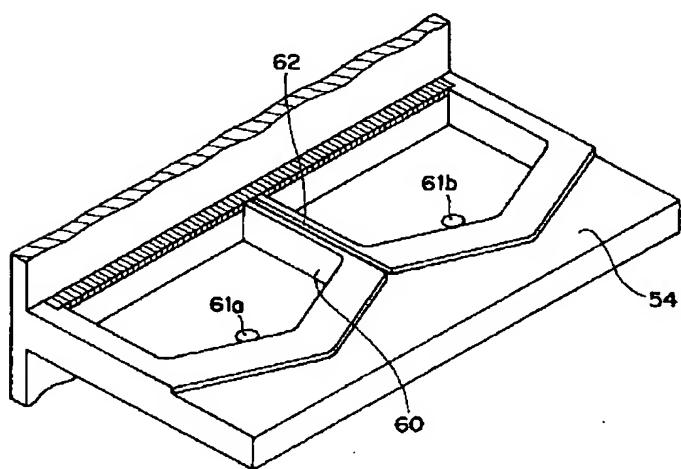
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Drawing selection drawing 19



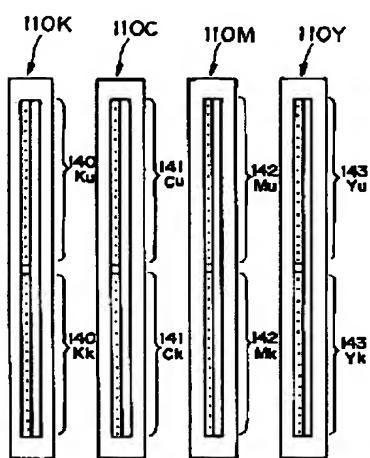
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Drawing selection drawing 20



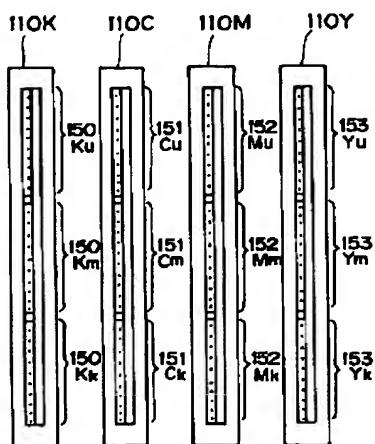
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Drawing selection drawing 21



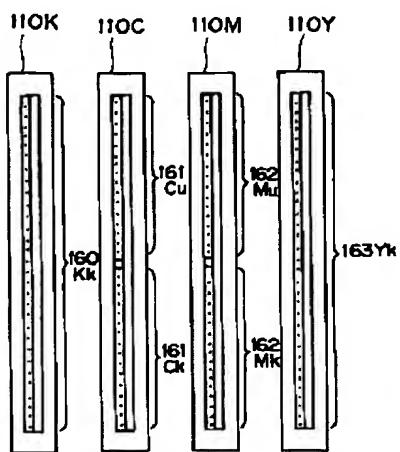
[Translation done.]

Drawing selection drawing 22



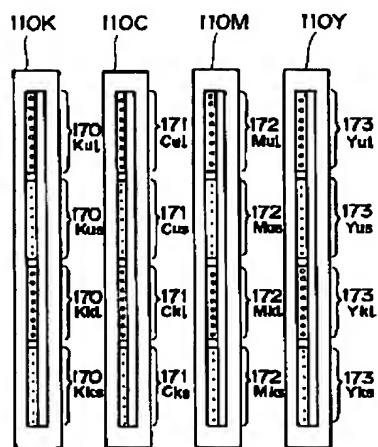
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Drawing selection drawing 23



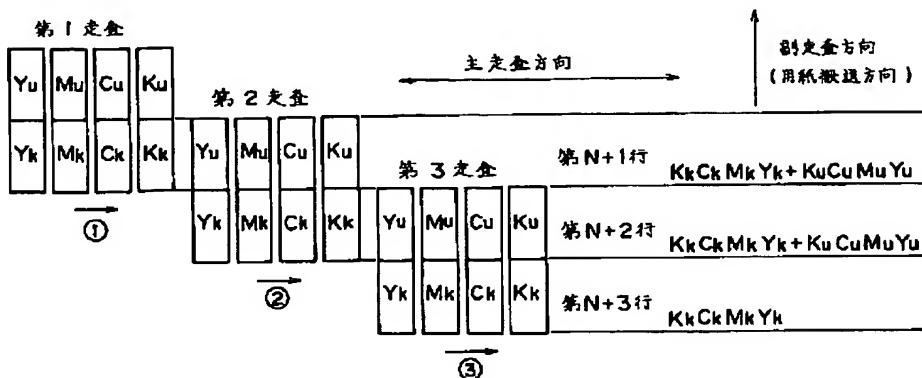
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Drawing selection drawing 24



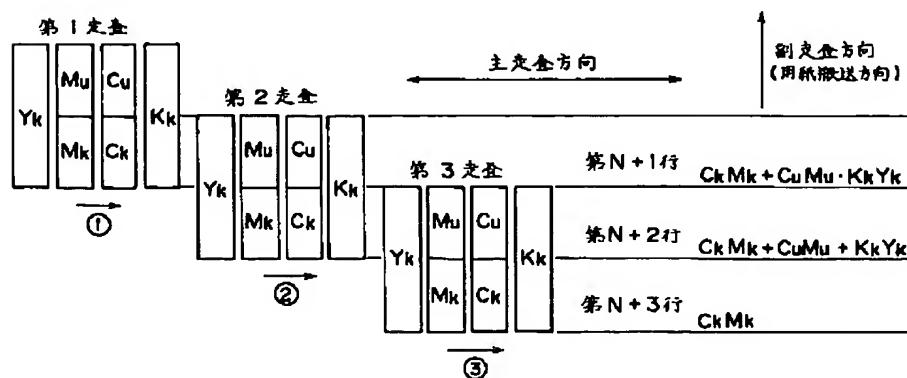
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Drawing selection drawing 25



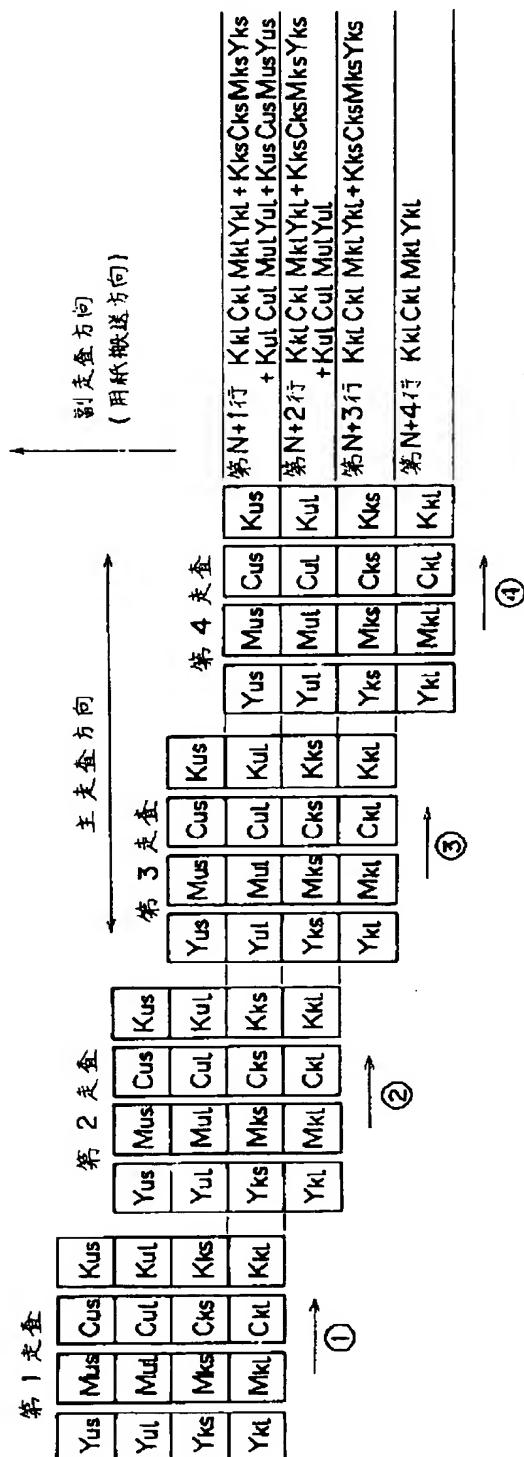
[Translation done.]

Drawing selection drawing 26



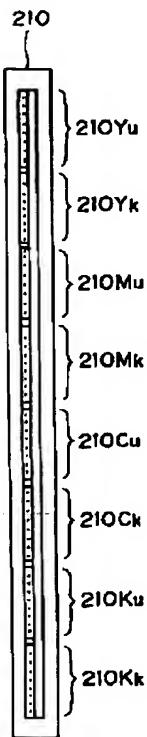
[Translation done.]

Drawing selection



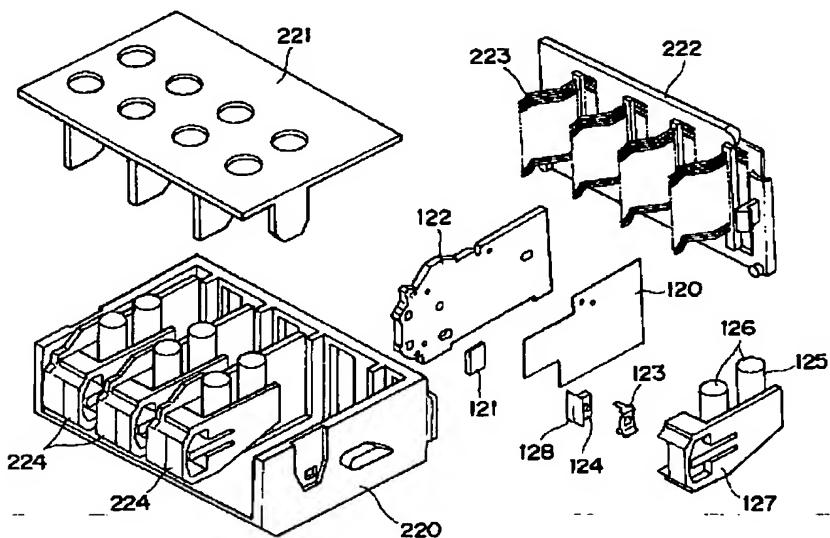
[Translation done.]

Drawing selection drawing 28



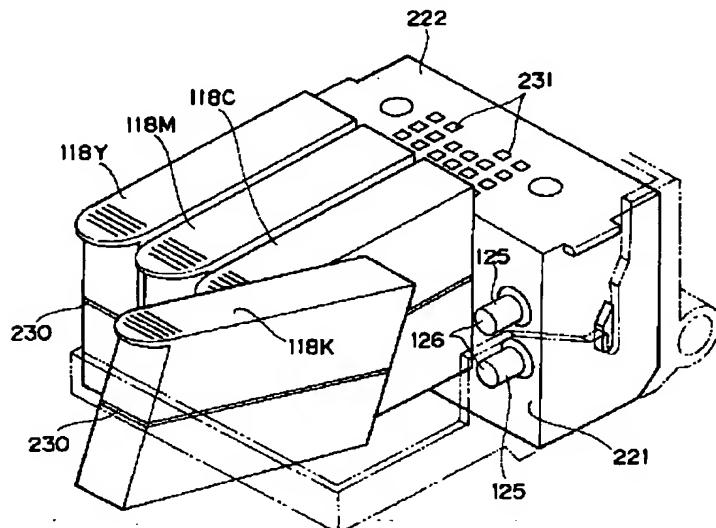
[Translation done.]

Drawing selection drawing 29



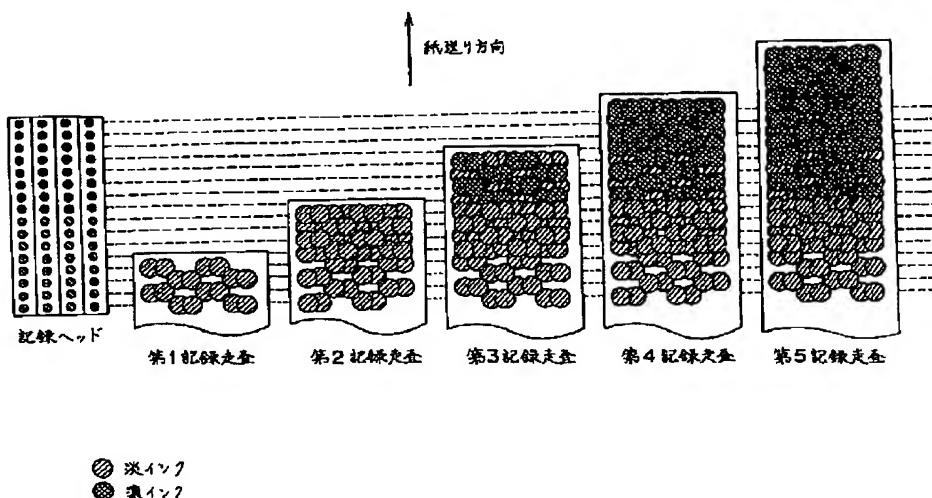
[Translation done.]

Drawing selection drawing 30



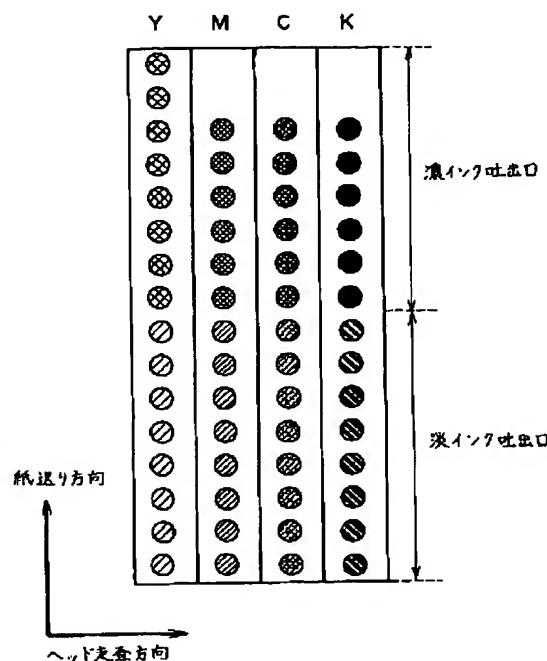
[Translation done.]

Drawing selection drawing 31



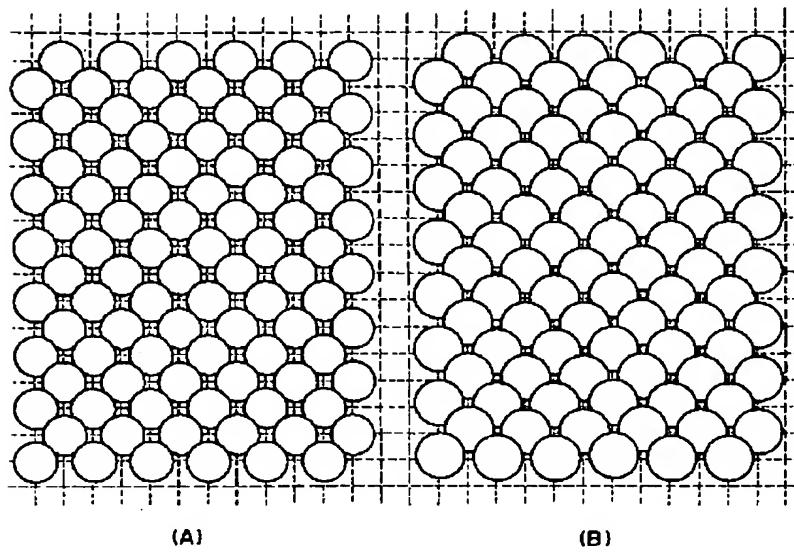
[Translation done.]

Drawing selection drawing 32



[Translation done.]

Drawing selection drawing 33

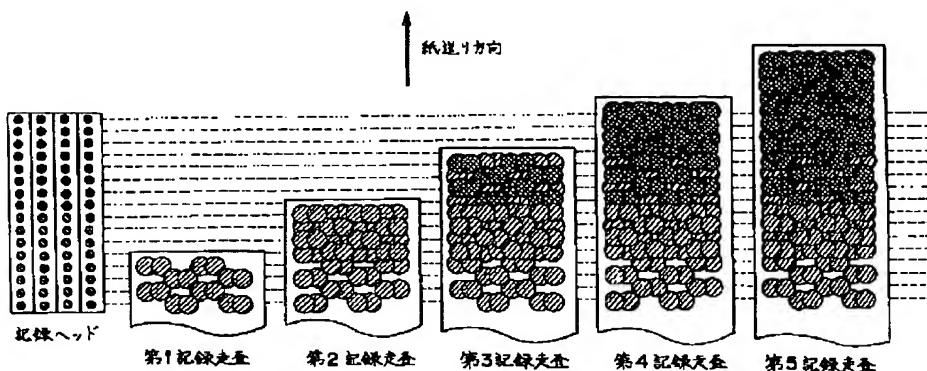


(A)

(B)

[Translation done.]

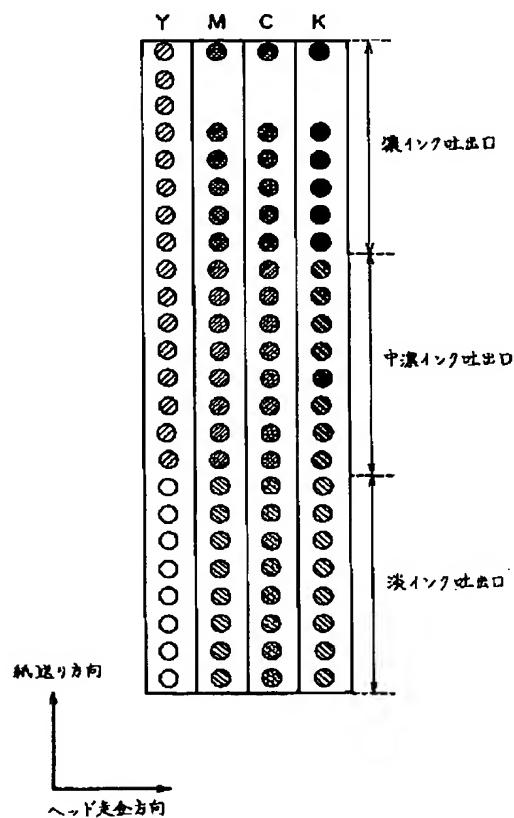
Drawing selection drawing 34



- 淡インク C → Y
- 淡インク Y → C
- 淡インク C → Y + 深インク C → Y
- 淡インク Y → C + 深インク Y → C

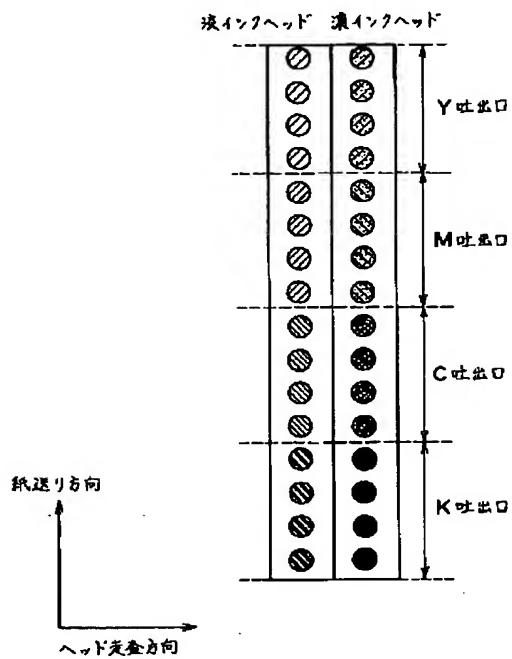
[Translation done.]

Drawing selection drawing 35



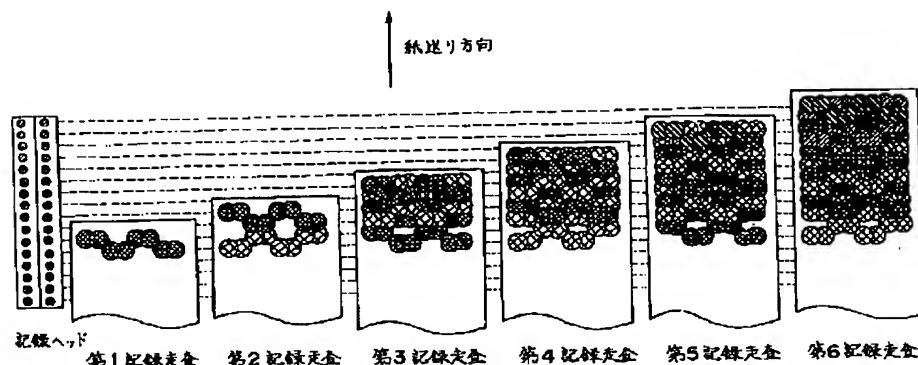
[Translation done.]

Drawing selection drawing 36



[Translation done.]

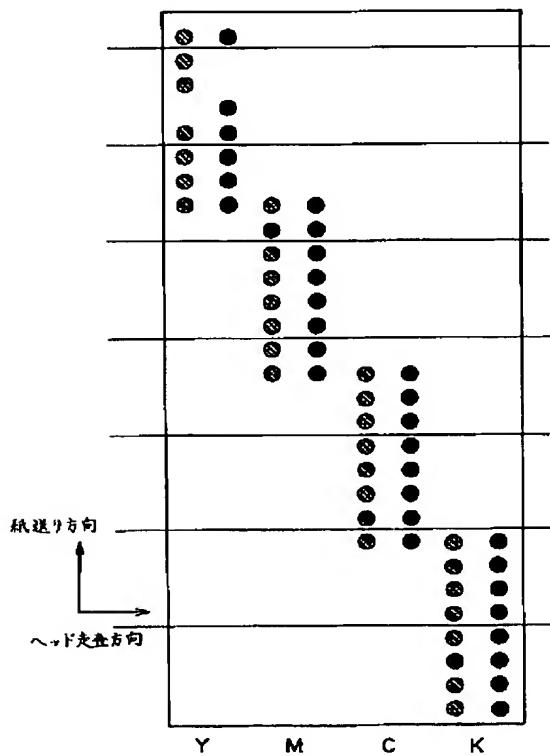
Drawing selection drawing 37



- Cインク 濃→淡
- Cインク 淡→濃
- ◎ Cインク 濃→淡 + Yインク 濃→淡
- ◎ Cインク 淡→濃 + Yインク 濃→濃

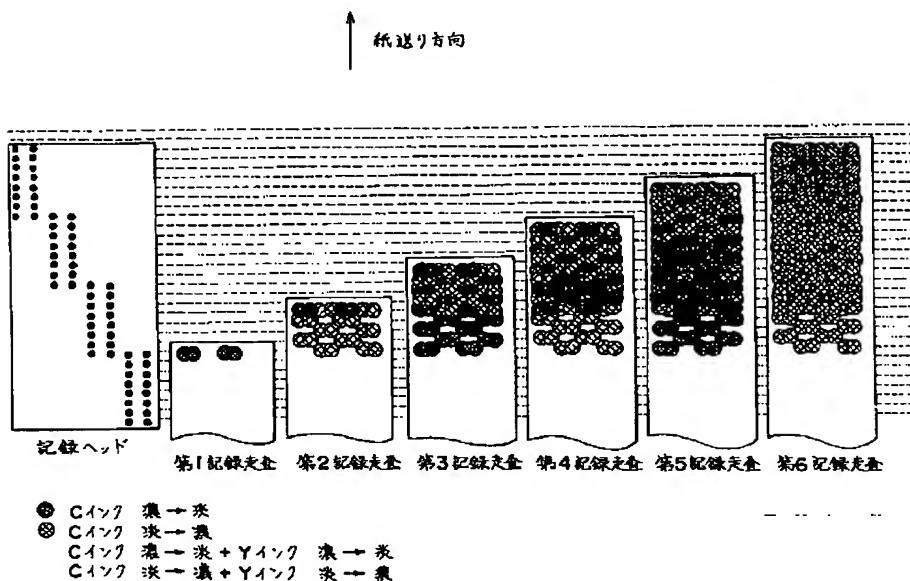
[Translation done.]

Drawing selection drawing 38



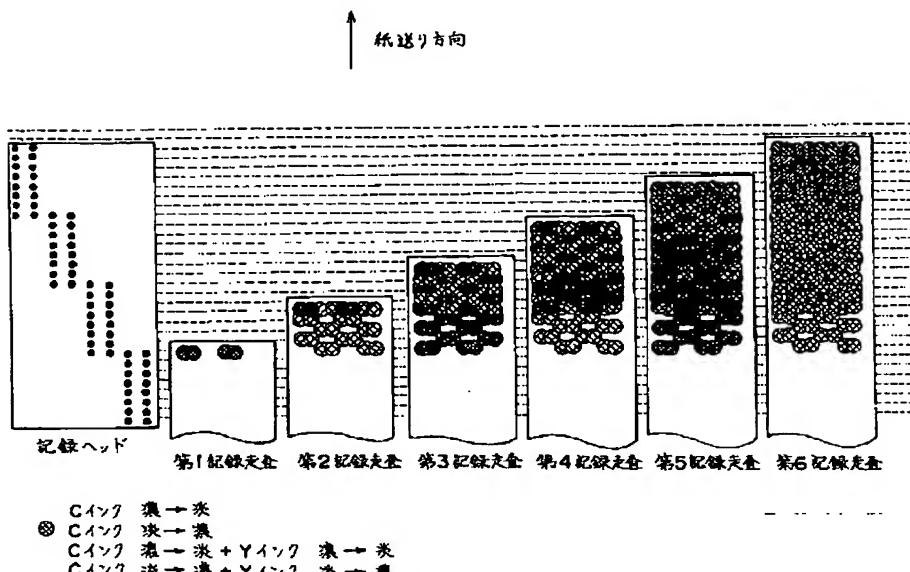
[Translation done.]

Drawing selection drawing 39



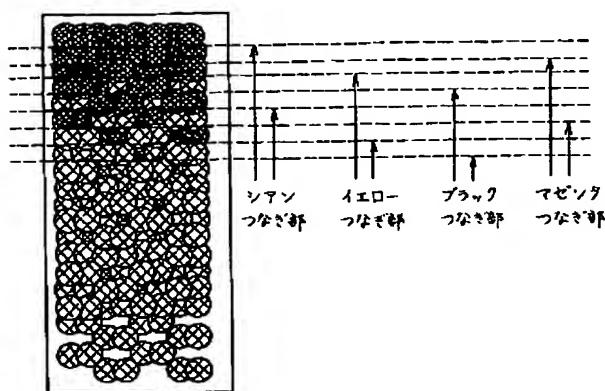
[Translation done.]

Drawing selection drawing 39



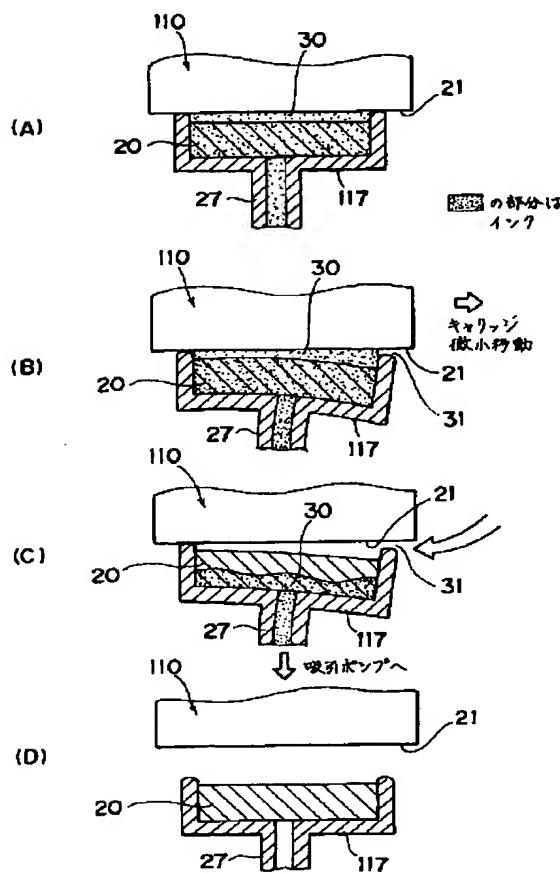
[Translation done.]

Drawing selection drawing 40



[Translation done.]

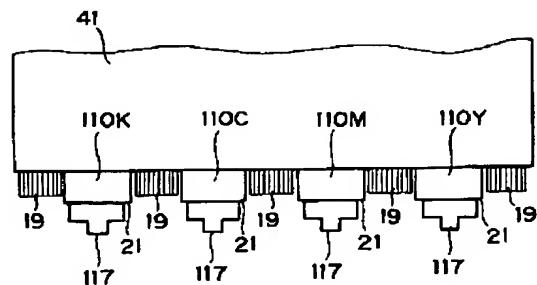
Drawing selection drawing 41



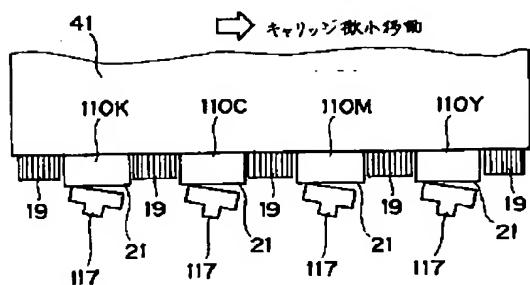
[Translation done.]

Drawing selection drawing 42

(A)

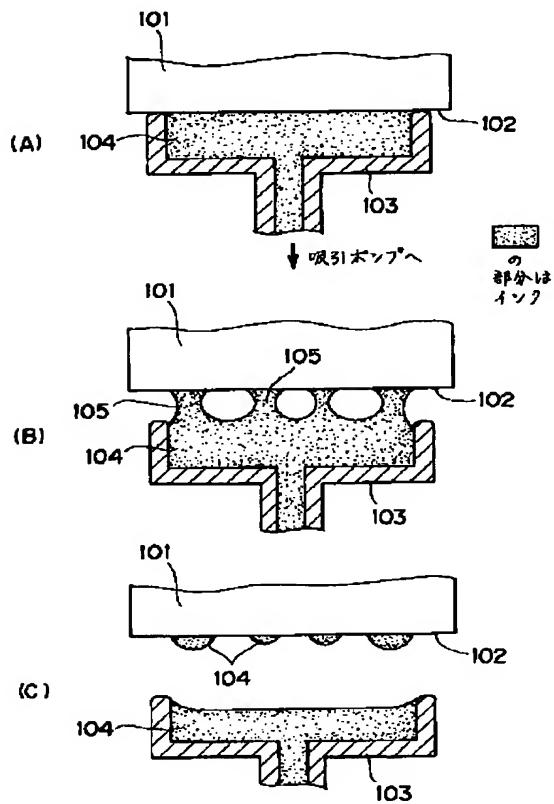


(B)



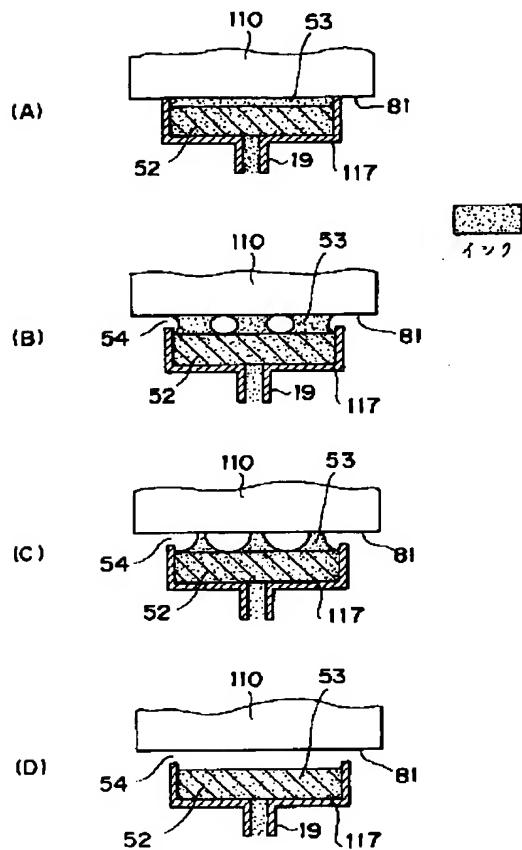
[Translation done.]

Drawing selection drawing 43



[Translation done.]

Drawing selection drawing 44



[Translation done.]

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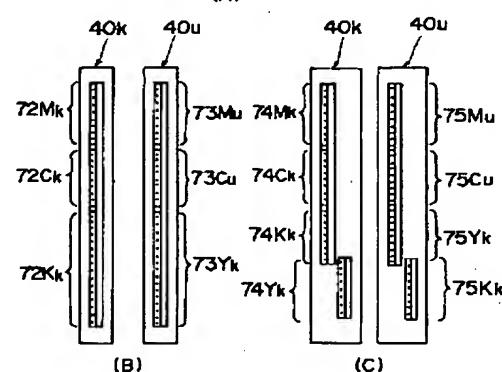
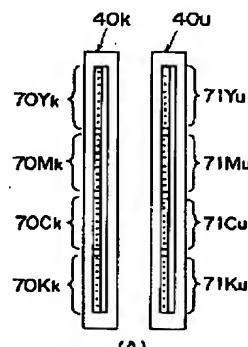
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(54)【発明の名称】 インクジェット記録装置およびインクジェット記録ヘッド

(57)【要約】

【目的】 同一インク色について濃度の異なる複数のインクを用いて記録を行うカラーインクジェット記録装置において、装置の小型化を可能とする。

【構成】 濃インクおよび淡インクを吐出するそれぞれの記録ヘッドユニット40kおよび40u内に、イエロー(Y)、マゼンタ(M)、シアン(C)およびブラック(K)の各インクを吐出する吐出口群70Yk, 70Mk, 70Ck, 70Kkおよび71Yu, 71Mu, 71Cu, 71Kuをそれぞれ一体に設ける。



(2)

【特許請求の範囲】

【請求項1】 インクを吐出するための記録ヘッドを用い、該記録ヘッドを主走査方向に移動させながら当該記録ヘッドから被記録媒体にインクを吐出して記録を行うインクジェット記録装置において、前記記録ヘッドは、それぞれが異なる濃度のインクを吐出するための複数の吐出口列を前記主走査方向とは異なる方向に一体に備えたことを特徴とするインクジェット記録装置。

【請求項2】 前記記録ヘッドは、前記異なる濃度のインクを吐出するための複数の吐出口列を、異なる色のインク毎に備えたことを特徴とする請求項1に記載のインクジェット記録装置。

【請求項3】 前記記録ヘッドは、前記異なる色のインク毎に備えられる複数の吐出口列を、前記主走査方向とは異なる方向に一体に備えたことを特徴とする請求項2に記載のインクジェット記録装置。

【請求項4】 前記記録ヘッドは、前記異なる色のインク毎に備えられる複数の吐出口列を、前記主走査方向に一体に備えたことを特徴とする請求項2に記載のインクジェット記録装置。

【請求項5】 インクを吐出するための記録ヘッドを用い、該記録ヘッドを主走査方向に移動させながら当該記録ヘッドから被記録媒体にインクを吐出して記録を行うインクジェット記録装置において、前記記録ヘッドは、前記主走査方向とは異なる方向に配列しそれぞれが異なる色のインクを吐出するための複数の吐出口列を、インクの濃度毎に前記主走査方向に配列して一体に備えたことを特徴とするインクジェット記録装置。

【請求項6】 前記異なる濃度または前記異なる色のインクを吐出する複数の吐出口列のそれぞれは、当該主走査方向とは異なる方向において当該吐出口列の一部が他の吐出口列の一部と重複するように配置されることを特徴とする請求項1ないし5のいずれかに記載のインクジェット記録装置。

【請求項7】 前記異なる濃度または前記異なる色のインクを吐出する複数の吐出口列のそれぞれは、当該主走査方向とは異なる方向において他の吐出口列と所定間隔をおいて配置されることを特徴とする請求項1ないし5のいずれかに記載のインクジェット記録装置。

【請求項8】 前記インクジェット記録装置は、前記記録ヘッドの複数の吐出口を覆ってインク吸引を行うためのキャップを有し、前記インク吸引時には前記記録ヘッドと前記キャップとの相対移動を行って当該記録ヘッドとキャップとの間に隙間を生じさせる動作を行うことを特徴とする請求項1ないし7のいずれかに記載のインクジェット記録装置。

【請求項9】 インクを吐出するための記録ヘッドを用い、該記録ヘッドを主走査方向に移動させながら当該記

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録ヘッドから被記録媒体にインクを吐出して記録を行うインクジェット記録装置において、

前記記録ヘッドは、インクを吐出するための複数の吐出口を前記主走査方向とは異なる方向に配列してなる吐出口列であって、前記主走査方向とは異なる方向に配列しそれぞれが異なる濃度のインクを吐出する複数の吐出口列を、当該インクの色毎に前記主走査方向に配列して備え、

前記記録ヘッドの1回の主走査で記録可能な領域の全画

10 素を、互いに補完の関係にある複数の間引き配列パターンに従って間引き、間引かれた画像を前記記録ヘッドの複数回の主走査および該主走査とは異なる方向の前記記録ヘッドと前記被記録媒体との複数回の相対移動を行つて記録することを特徴とするインクジェット記録装置。

【請求項10】 インクを吐出するための記録ヘッドを用い、該記録ヘッドを主走査方向に移動させながら当該記録ヘッドから被記録媒体にインクを吐出して記録を行

うインクジェット記録装置において、

前記記録ヘッドは、インクを吐出するための複数の吐出口を前記主走査方向とは異なる方向に配列してなる吐出口列であって、前記主走査方向とは異なる方向に配列しそれぞれが異なる色のインクを吐出する複数の吐出口列を、当該インクの濃度毎に前記主走査方向に配列して備え、

前記記録ヘッドの1回の主走査で記録可能な領域の全画素を、互いに補完の関係にある複数の間引き配列パターンに従って間引き、間引かれた画像を前記記録ヘッドの複数回の主走査および該主走査とは異なる方向の前記記録ヘッドと前記被記録媒体との複数回の相対移動を行つて記録することを特徴とするインクジェット記録装置。

【請求項11】 前記記録ヘッドは、熱エネルギーを利用してインクに気泡を生じさせ、該気泡の生成に基づいてインクを吐出することを特徴とする請求項1ないし10のいずれかに記載のインクジェット記録装置。

【請求項12】 インクジェット記録に使用されるインクジェット記録ヘッドにおいて、インクを吐出する吐出口を、それぞれが異なる濃度のインクを吐出する複数の吐出口を当該インクジェット記録ヘッドの使用時の移動方向とは異なる方向に配列して一体に備えたことを特徴とするインクジェット記録ヘッド。

【請求項13】 前記記録ヘッドは、熱エネルギーを利用してインクに気泡を生じさせ、該気泡の生成に基づいてインクを吐出することを特徴とする請求項12に記載のインクジェット記録ヘッド。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 本発明はインクジェット記録ヘッドおよびインクジェット記録装置の記録に関し、特に、50 同系色について濃度の異なるインクを用いて画像を記録

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するためのインクジェット記録ヘッドおよびインクジェット記録装置に関する。

【0002】

【従来の技術】複写装置や、ワードプロセッサ、コンピュータ等の情報処理機器、さらには通信機器の普及に伴い、それらの機器における情報出力手段としての画像形成装置（以下、記録装置ともいいう）の一つとして、インクジェット方式による記録ヘッドを用いてデジタル画像記録を行うものが急速に普及している。このような記録装置においては、記録速度の向上のため、記録素子としてインク吐出口およびこれに連通する液路等を複数集積したいわゆるマルチノズルヘッドを使用したものが一般的である。

【0003】この方式の記録装置において中間調を表現する方式としては、一定サイズの記録ドットにより単位面積当たりの記録ドット数を制御して中間調を表現するドット密度制御方式や記録ドットのサイズを制御して中間調を表現するドット径制御方式が多く用いられる。

【0004】ここで、後者のドット径制御方式は、一般に、記録ドットのサイズを微妙に変更するための複雑な制御が必要となる等の制約があるため、用いられることが少なく、特に、インク吐出に利用されるエネルギーを発生するエネルギー発生手段として電気熱変換素子を用いた場合、この素子を用いた記録ヘッドは、製造が比較的容易であり、また、吐出口等を高密度に配することができるため高解像度の記録が可能である等の利点を有するものであるが、吐出の際にインクに及ぼす圧力を変化させることが困難であり、従って、記録ドットの径を変調することが困難であるためドット径制御方式を用いることは少ない。以上の理由からインクジェット方式の記録ヘッドを用いた場合、ドット密度制御方式に用いることが多い。

【0005】一方、ドット密度制御法に用いられる中間調表現の2値化手法の代表的なもののひとつとして、組織的ディザ法があるが、この方法は階調数がディザマトリクスのサイズによって制限されるという問題がある。即ち、階調数を多くするためにはマトリクスサイズを大きくする必要があるが、マトリクスサイズを大きくすると1つのマトリクスで構成される記録画像の1画素が大きくなつて解像力を損なうなどの問題がある。

【0006】これに対して、2値化手法のもうひとつの代表的なものとして、誤差拡散法などの条件付決定型ディザ法がある。これは、前述した組織的ディザ法が、入力画素に無関係なしきい値を用いて2値化する独立決定型ディザ法であるのに対し、入力画素の周辺画素を考慮してしきい値を変化させる方法である。この誤差拡散法に代表される条件付決定型ディザ法は、階調性と解像力の両立性が良く、また原画像が印刷画像の場合、記録画像にモアレパターンが発生することが極めて少ないなどの長所がある。

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【0007】しかし、その反面、記録画像の明部で粒状性が目立ち易く、画質が低下するという問題があり、また、この問題は、特に記録密度の低い記録画像において顕著となる。

【0008】上述のような粒状性の問題を解決するものとして、従来より、同一色のインクについて濃度の異なるインクをそれぞれ吐出する複数の記録ヘッドを設け、画像の明部から中間調部分は濃度の低いインク（淡インク）で記録ドットを形成し、中間調部分から暗部までは濃度の高いインク（濃インク）で記録ドットを形成するような記録方法が提案されている。

【0009】図1は、上記記録方法にかかる濃淡インクを用いたシリアルプリント方式による従来例のカラーインクジェット記録装置の要部を示す斜視図である。

【0010】ブラックの濃インクを吐出する記録ヘッドKk、ブラックの淡インクを吐出する記録ヘッドKu、シアンの濃インクを吐出する記録ヘッドCk、シアンの淡インクを吐出する記録ヘッドCu、マゼンタの濃インクを吐出する記録ヘッドMk、マゼンタの淡インクを吐出する記録ヘッドMu、イエローの濃インクを吐出する記録ヘッドYk、イエローの淡インクを吐出する記録ヘッドYuは、それぞれキャリッジ241に所定距離をおいて配設されている。キャリッジ241は、ガイドシャフト243により摺動自在に案内支持され駆動ベルト244を介したキャリッジモータ245の駆動により上記ガイドシャフト243に沿つて往復移動させられる。

【0011】各記録ヘッドのインク吐出口に連通する液路にはインク吐出に用られる熱エネルギーを発生する発熱素子（電気熱変換素子）が設けられている。

【0012】各記録ヘッドで用いられるインクはそれぞれの色に対応して設けられたインクカートリッジ248に貯留され、個々のインク供給経路を介して供給される。また、装置制御部から記録ヘッドへの制御信号や駆動信号の転送は、フレキシブルケーブル249を介して行われる。

【0013】記録用紙やプラスチック薄板等から成る被記録材は不図示の搬送モータを駆動源とする搬送ローラ（不図示）および排紙ローラ242により、図中矢印方向に搬送され、この間に各記録ヘッドの移動に伴なつて対向する面に記録がなされて行く。すなわち、キャリッジ241の移動位置を検出するエンコーダ（不図示）の読み取りタイミングに従い、上記発熱素子を記録信号に基いて駆動し、ブラックの濃、淡、シアンの濃、淡、マゼンタの濃、淡、イエローの濃、淡の各インクの順に被記録材上にインク液滴を吐出、付着させることで画像を記録することができる。

【0014】キャリッジ241の移動による記録領域外に設定されたホームポジションには、キャップ部247をもつ回復ユニット246が配設され、この回復ユニットによる吐出回復処理によって各記録ヘッドのインク吐

(4)

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出特性の安定化を行う。

【0015】

【発明が解決しようとする課題】以上説明した、従来の濃淡インクを用いるインクジェット記録装置は、記録画像における粒状性の問題を比較的良く解決するものであり、画質向上のための有効な手法の1つではあるが、以下に示すような、大別して2つの問題点がある。

【0016】1) 第1に、従来の濃淡インクを用いたインクジェット記録装置は、使用するインク毎に記録ヘッドおよびインクカートリッジを設けていたため、記録ヘッドの数およびインクカートリッジの数が増し、記録装置が大型化するという問題がある。

【0017】また、記録ヘッドおよびキャリッジの重量も増すことになり、キャリッジ移動時のランプアップダウンの距離が長くなり、同様に装置が大型化する。また、上記重量増大によりキャリッジを駆動させるため負荷が増大し、トルクの大きな駆動モータを用いる必要や、記録ヘッドの数に応じて多数個設けられるキャップのキャッピング性能維持のための複雑な機構の必要を生じ、そのためのコストが増すという問題がある。

【0018】さらに、記録ヘッドの数が多くなることから、各色記録ヘッドのレジストレーションをより精度良く行う必要があり、そのために部品精度を高くした高価な部品を用いたり、複雑な位置合せ調整や補正制御を行う必要があった。

【0019】加えて、濃淡インクを用いて記録を行うときに、濃淡インク間のドット濃度の差が大きい場合、記録画像における淡インクと濃インクの切り換え部分で階調の再現が線形にならず、疑似輪郭が生じ易くなっていた。また、記録された画像の粒状性の変化や色調の変化が、上記インク切り換え部分で発生して不自然な画像となる問題もあった。このような問題を解決するために、低濃度インク、中濃度インク、高濃度インクを用いるなど、濃度の段階を増して記録を行う方法があるが、上述のサイズに関する問題をより助長することは明らかである。

【0020】2) 第2に、カラー記録を行う場合の複数色のインクそれぞれについて濃度の異なるインクを用いる場合において、各色インクの重なりの順序および同一色で濃度の異なるインクの重なりの順序にそれぞれに起因した記録画像におけるむら等を容易に解消できないという問題がある。

【0021】上記むら等を解消する従来の手法としては、濃度むらを解消するのと同様のものを用いることができることが知られている。これについて以下に説明する。

【0022】例えばカラープリンタにおいては、キャラクタープリンタ等の文字のみ記録するものと異なり、イメージ画像を記録するにあたって、発色性、階調性、一様性など様々な条件が必要となる。特に、一様性に関し

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て、マルチノズルヘッドの製作工程で生じるわずかな吐出口毎のばらつきは、記録の際の各吐出口のインクの吐出量や吐出方向の向きに影響を及ぼし、結果として記録画像の濃度むらとして画像品位を劣化させる原因となる。

【0023】その具体例を図2、図3を用いて説明する。

【0024】図2(A)において、91はいわゆるマルチノズルヘッドであり、簡単のため単色、単濃度の1種類のインクのみを吐出する8個の吐出口92によって構成されているものとする。93は各吐出口92から吐出されたインクドロップレットであり、同図のようにインクドロップレット93は同一の吐出量で、同一の方向に吐出されるのが理想である。そして、このような吐出が行われれば、図2(B)に示すように、紙面上に等しい大きさのドットが記録され、全体的に濃度むらの無い一様な画像が得られる(図2(C)参照)。

【0025】しかし、実際には先にも述べたように、吐出口毎にそれぞればらつきがあることが多く、図3(A)に示すように、それぞれの吐出口より吐出されるインクドロップの量および方向にばらつきが生じ、図3(B)に示すような記録ドットの大きさや着弾位置のばらつきが生じる。この結果、記録ヘッドの主走査方向に沿ってエリアファクター100%を満たせない白紙の部分が存在したり、また、逆に必要以上にドットが重なり合ったり、あるいはこの図3(B)の中央に見られるような白筋が発生する。この場合、濃度分布は図3(C)に示すものとなり、結果的には、通常人間の目でみた限りで、濃度むらとして感知される。

【0026】また、1回の記録走査毎に繰り返される紙送りの量が一定に制御されない場合にも、同様の濃度むら等を生じる。例えば、一定量より多く紙送りがなされる場合、各走査領域の端部のドットとドットが規定量より離れた位置に記録され、その部分は白スジとして目立つことになる。逆に、一定量より少なく紙送りがなされる場合、端部のドットとドットは必要以上に重なり合い、黒スジとして目立つことになる。この紙送り量の値は画素密度が高くなればなる程、厳密な制御が要求され、これが満たされない場合には、記録画像上につなぎスジが発生することになる。

【0027】以上のような濃度むらやスジの発生を防止するため次のような方法が提案されている。

【0028】図4、図5によりその方法を説明する。これら図に示すように、この方法によれば、図2および図3で示した記録領域を完成させるのに記録ヘッド91を3回走査させる必要があるが、その領域の半分、すなわち記録ヘッドの吐出口配列の半分に相当する領域は2回の走査で完成する。すなわち、この場合、記録ヘッドの8個の吐出口は、上4吐出口と、下4吐出口の2グループに分けられ、1回目の走査では下4吐出口を用いてそ

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れぞれ4つの画素列のドットを記録し、4吐出口分の紙送りをした後、2回目の走査では上4吐出口を用いて上記4つの画素列のドットが記録されていない部分にドットを記録する。このとき、2回の各走査では、2回の走査で記録すべきドットが約半分に間引かれており、各走査で記録されるドットは相補的な関係にある。このような記録法を、以下では分割記録法と称す。

【0029】このような分割記録法を行えば、図3で示したような吐出口毎に吐出特性のばらつきのある記録ヘッドを使用しても、各吐出口毎の記録画像への影響が半減されるので、記録された画像は図4 (B) に示すようになり、図3 (B) に見るような黒スジや白スジがそれ程目立たなくなる。従って、濃度むらも図4 (C) に示すように図3 (C) の場合と比較して、かなり緩和される。また、各走査領域の境界に生じるつなぎスジも、この分割記録法を行えば、記録ヘッド端部の吐出口と記録ヘッド中央部の吐出口によって1つ画素列のドットが記録されるので、半減させることができる。

【0030】このような記録を行う際、1スキャン目と2スキャン目では、画像データを、ドットがある決まった配列に従い互いに埋め合わせるように（相補的に）分割するが、通常、この画像データ分割（以下、間引きパターンともいう）は、図5に示すように、ドットが縦横1画素毎に、丁度千鳥格子になるようなものを用いるのが最も一般的である。従って、単位記録領域（ここでは4画素単位）においては千鳥格子を記録する1スキャン目と、逆千鳥格子を記録する2スキャン目によって記録が完成される。

【0031】図5 (A), (B) および (C) はそれぞれこの千鳥、逆千鳥パターンを用いたときに一定領域の記録がどのように完成されて行くかを説明したものである。まず1スキャン目では、下4ノズルを用いて千鳥パターンを形成するドット51の記録を行う（図5 (A)）。次に、紙送りを4画素分（ヘッド長の1/2）だけ行った後、2スキャン目では逆千鳥パターンのドット52の記録を行う（図5 (B)）。さらに3スキャン目には、再び4画素（ヘッド長の1/2）だけの紙送りを行った後、再び千鳥パターンのドット53の記録を行う（図5 (C)）。このようにして順次4画素単位の紙送りと、千鳥、逆千鳥パターンの記録を交互に行うことにより、4画素単位の記録領域を1スキャン毎に完成させていく。以上説明したように、同じ画素列のドットが異なる2種類の吐出口により記録されていくことにより、吐出口毎の吐出特性のばらつきの影響を平均化し濃度むらの少ない高画質な画像を得ることが可能となる。

【0032】このような記録方法は、例えば特開昭60-107975号公報やUSP4967203号公報に既に開示されているものであり、濃度むらやつなぎスジに対して有効であることがそれぞれに述べられている。

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前者においては「各主走査の紙送りを該主走査の幅より少なくし、隣接する2回の主走査を重複させて重複部分を形成する手段と、該重複部分の印字ドットを2回の主走査で重ならないよう配列する手段を備えたことを特徴とする」と開示されている。本公報では、間引きマスクを「1列おきに奇数段と偶数段を互い違いに印写」としている場合もあるが、その他にも1回目の主走査で奇数段、2回目の走査で偶数段を印写している場合や、各走査でランダムに記録する場合もあり、間引きマスクおよび紙送り幅は完全には限定していない。

【0033】これに対し後者のUSP4967203号公報においては、

「a) 第1のパスで第1の帯内の上半分のみ水平垂直方向に隣接しない交番的なピクセル位置をプリントし、
b) 第2のパスで第1の帯内の第1のパスでプリントされなかったピクセルと、第1の帯内の下半分の水平垂直方向に隣接しない交番的なピクセルにプリントし、
c) 第3のパスで第1、第2のパスでプリントされなかった第1の帯内のピクセルのプリントをすると同時に、
直後に引き続く帯に第1のパスを行う」

と開示されている。このように本公報においては、分割記録を行う間引きマスクとして垂直水平方向に隣接しない交番的なピクセル配列を限定している。

【0034】本公報においてさらに付け加える構成として、階調表現やマルチカラー表現のために数画素まとめて疑似画素（スーパーピクセル）を形成し、疑似画素（スーパーピクセル）単位で水平垂直方向に隣接しない交番的な間引きプリントを行う記録法が開示されている。そして、この方法によれば「上記方法を実現するためのシステムをいったんプログラム・ソフトウェアかプリンタ・フォームウェアのどちらか組み込んでしまえば、プログラムはスーパーピクセルに関して指定された組み合わせの色彩番号で呼び出す事ができるので、多数の色彩を作り出すためのコンピュータ・プログラムを作成する作業をむやみに複雑にすること無くこのプリントの質が達成される。」と述べ、マルチカラー表現の為のプログラミングの単純化も効果として上げている。また、各スーパーピクセルは単一の均質な色彩として知覚されることを意図しているので、スーパーピクセル内のカラーのじみは無害であるとも述べている。

【0035】ところで、記録走査方向に複数色の記録ヘッドを並べる構成の従来のプリンタにおいて記録速度を向上させるために両方向記録を行う場合、上記分割記録法を用いない場合には、上述したむらの発生と同時に色むら等も発生することがある。以下、その理由を述べる。

【0036】現在一般に使用されている記録インクの被記録媒体（紙）への着弾状態を図6の断面図に示す。ここでは異なる2色のインク（ドット）を時間差をおいて殆ど隣接した位置に吸收（記録）させた場合を示してい

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る。注意点は、2ドット重なり部分において、先に記録されたドットよりも後に打たれたドットの方が紙面の深さ方向に沈む傾向にあることである。これは、吐出されたインク中の染料などの色素が被記録媒体と物理的かつ化学的に結合する段階で、被記録媒体と色素の結合が有限であるために、色素の種類によって結合力に大きな差がない限りにおいては、先に吐出されたインクの色素と被記録媒体との結合が優先されるためにその色素が被記録媒体表面に多く残り、後から打たれたインクの色素は被記録媒体表面では結合しにくく、紙面深さ方向に沈んで結合するものと考えられるからである。

【0037】この場合、2種類のインクを同着弾点に記録した場合も、同様に2種類のインクの打ち込み順序によって優先色が異なることとなるため、結果的に人間の視覚特性に対し、打ち込み順序によって異なる2色を表現してしまうことになる。例えば、ある一定領域にグリーン（シアン+イエロー）画像を形成する場合に、各画素にシアン、イエローの順にインクを打ち込んだ時は、先に吸収されたシアンが優先色となり、シアンの発色の強いグリーン画像となる。逆に、イエロー、シアンの順にインクを打ち込んだ時は、イエローの発色の強いグリーン画像が得されることになる。

【0038】ここで、両方向記録を行う場合を考えると、例えば図1に示すように各色の記録ヘッドが記録走査方向に配列されているので、往路で記録されるインクの打ち込み順と、復路で記録されるインクの打ち込み順は逆転する。従って、往路で記録されるドットの発色と復路で記録されるドットの発色は異なったものとなる。このような状態で、通常行われる1回の記録走査毎の吐出口配列の長さ分の紙送りを行っていくと、異なる2種類の色調や濃度が1走査ライン毎に交互に現れ、記録画像全体では大きな色むらとなり画質を劣化させることになる。

【0039】しかし、このような弊害も前述した分割記録法を用いることにより克服することができる。すなわち、分割記録を行うことにより、図5で説明したように、往路（図5（A）、（C））で記録されるドットの発色と、復路（図5（B））で記録されるドットの発色が、一定領域内にほぼ半数づつ混在させることができる。全体的には双方のドットの発色性の差が平均化され、丁度中間の発色がどの記録領域でも同様に得られる。

【0040】発色性に関する上述の構成および効果は、例えばU.S.P.4,748,453号公報に既に開示されている。ここでは紙送り量の限定はないが、第1と第2（あるいはそれ以上）に分割した記録走査でそれぞれの記録領域に水平垂直方向に交互に位置する画素への補完的な記録をすることにより、トランスペアレンシーフィルム等の被記録媒体上でのインクのビーディングを防止する際の、カラー画像を形成するときには、混色画素のイン

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ク打ち込み順を第1走査と第2走査で逆転させることにより（往復記録）、カラーバンディング（色むら）を防止することができる効果を述べている。この公報においては主な目的が各画素間のビーディングの防止であるので、1回の走査で記録される画素同士は、水平垂直方向において互いに隣接しないことが特徴づけられている。

【0041】一方、本願人による特開昭58-194541号公報においては、「複数本の記録素子列を並列配置し、前記記録素子列に直行する方向に往復走行させて、ドット行列記録の主走査を行うにあたり、前記主走査の往路において記録ドット行列の各行および各列の少なくとも一方における記録すべき全ドットよりも少ない個数のドットを間欠的に記録するとともに、前記主走査の復路において前記各行および各列の少なくとも一方における残余のドットを間欠的に記録することにより前記複数本の記録素子列による重複記録ドットにおける記録の重複の順序を前記主走査の往路と復路とにて互いに異ならせることを特徴とする記録方法」と開示している。この公報においても先に説明した分割記録のように紙送り量を記録素子列の長さ分より少なくするような制限はなく、その効果をカラーインクの重複記録（重ね記録）に基づく記録画像の色調ずれ（色むら）による画像劣化の防止としている。この公報においては、この色調ずれの防止が主な目的であるので、各走査で記録するドット位置の特別な制限は無く、実施例においては市松模様（千鳥、逆千鳥）に加え、縦方向にのみ交互に記録する横間引き、横方向にのみ交互に繰り返す縦間引きが記載されている。

【0042】また、カラープリンタに限定していないが、特開昭55-113573号公報においても、綾目状（千鳥、逆千鳥）パターンを用いて往復記録を行う構成を開示している。この公報では隣接するドットを連続して印写しないようにし、それによって印写ドットが乾かないうちに隣接するドットを印写してドット歪が生じるのを防止することを目的としている。従って、ここでは上記U.S.P.4,748,453号公報と同様に、間引きマスクが綾目状に限定されている。

【0043】ところで、上記3件の公報は全て、往復記録時の色むらやビーディングの防止を目的としている。従って、本願で開示する分割記録法のよう、吐出口のばらつきに起因する濃度むら防止を目的の1つとして「各走査間の紙送り量を吐出口配列の長さ以下にする」という構成はとっていない。また、濃度の異なる2種類以上のインクを用いて記録する場合についても何も開示するものではない。

【0044】以上説明したように、往復記録において分割記録を行えば、インク色の打ち込み順が互いに逆である2種類の記録画素を記録領域内に均等に配することができるので、吐出口のばらつきに起因した濃度むら解消と同時に色むらの解消も可能となる。

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【0045】しかしながら、インク打ち込み順によりドット定着状態が異なるという現象は、上述した色むらに限らず、濃度の異なるインクを重ねて打ち込む場合においても同様のことが言える。すなわち、濃度の高いインクのドットを先に記録した場合には、このドットの濃度が優先的となり、濃度の高いくっきりとした画像が得られる。これに対し、濃度の低いインクが打たれた後に、濃度の高いインクを記録した場合には、そのインクが濃度の低いインクの周りに大きく滲み込み、それほど濃度の高くない滑らかで一様な画像が得られる。

【0046】以上説明したように、複数種のインクを用いてカラー記録を行う場合において、記録画像における粒状性を考慮して複数種の各インクについてさらに濃度の異なる複数のインクを用いると、各種インク間の重なり順序に起因した色むらに加え、濃淡インク間の重なり順序に起因した濃淡むらも生じ、これら色むら、濃淡むらの現れ方がより多様となる。

【0047】さらに詳しく説明すれば、図1に示したインクジェット記録装置において、上述のようなカラー記録を行う場合に用いられる従来の記録ヘッドK k～Y uは図7に示すような配列である。このため、カラー記録を行う際の走査によって可能となる濃、淡を含めた各種インクの重なり方の組合せは濃、淡インクを用いない場合と比較してより多様なものとなる。

【0048】このため、上述のように単に上記分割記録法を用いることによって色むら、濃淡むらを平均化しようとしても、十分でない場合がある。また、後述されるように各画素に打ち込まれるインクの滲む面積に起因して色むら等を解消しきれないこともある。

【0049】本発明は、上述した濃、淡インクを用いる場合に生じる第1および第2の問題を解決し、小型でその記録画像におけるむらが抑制されたインクジェット記録装置を提供することを目的とする。

【0050】

【課題を解決するための手段】そのために本発明では、インクを吐出するための記録ヘッドを用い、該記録ヘッドを主走査方向に移動させながら当該記録ヘッドから被記録媒体にインクを吐出して記録を行うインクジェット記録装置において、前記記録ヘッドは、インクを吐出する吐出口を前記主走査方向とは異なる方向に配列してなる吐出口列であって、それぞれが異なる種類のインクを吐出する複数の吐出口列を前記主走査方向とは異なる方向に一体に備えたことを特徴とする。

【0051】また、インクを吐出するための記録ヘッドを用い、該記録ヘッドを主走査方向に移動させながら当該記録ヘッドから被記録媒体にインクを吐出して記録を行うインクジェット記録装置において、前記記録ヘッドは、インクを吐出する吐出口を前記主走査方向とは異なる方向に配列してなる吐出口列であって、それぞれが異なる種類のインクを吐出する複数の吐出口列を前記主走

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査方向とは異なる方向に備え、前記記録ヘッドと前記被記録媒体とを、前記主走査方向とは異なる方向に、前記複数の吐出口列が延在する幅より少い幅だけ相対移動を行い、該移動毎に、前記記録ヘッドの前記主走査方向の1回の移動で記録可能な画素の一部を、前記1回の移動で記録し、前記記録可能な画素の残余を他の前記1回の移動で記録することを特徴とする。

【0052】さらに、インクを吐出する吐出口を、当該使用時の移動方向とは異なる方向に配列してなる吐出口列であってそれが異なる種類のインクを吐出する複数の吐出口列を前記移動方向とは異なる方向に一体に備えたことを特徴とする。

【0053】

【作用】以上の構成によれば、濃度や色等、種類がそれぞれ異なるインクを吐出する複数の吐出口列を、その記録ヘッドの移動方向とは異なる方向に一体に設けることができるので記録ヘッドそのものや、これを移動させるための機構の小型化が可能となる。

【0054】また、1回の移動で記録可能な領域を分割し、かつこの分割領域の画素を複数回の移動によって分割して記録する場合には、記録ヘッドにおける上記複数の吐出口列の配置によって、記録ヘッドの上記複数の種類の異なるインクの重なる順序を常に等しくすることができる。

【0055】

【実施例】以下、図面を参照して本発明の実施例を詳細に説明する。

【0056】実施例1

(記録装置構成) 図8は本発明の一実施例におけるカラーインクジェット記録装置の制御構成を示すブロック図である。

【0057】図において、符号1はCCD等による原稿画像を光学的に読み取り。あるいはホストコンピュータやビデオ機器等から画像輝度信号(RGB)を入力する画像入力部を示し、符号2は各種パラメータの設定および記録開始を指示する各種キーを備えている操作部を示す。符号3は後述のROM中の各種プログラムに従って本記録装置全体を制御するCPUを示す。符号4は制御プログラム、エラー処理プログラムに従って本記録装置を動作させるためのプログラム等を格納するROMを示す。このROMにおいて、符号4aは後述する入出力ガンマ変換回路の処理で参照するための入出力ガンマ変換テーブル、符号4bは後述の色補正(マスキング)回路の処理で参照するマスキング係数、符号4cは後述の黒生成およびUCR回路の処理で参照する黒生成およびUCRテーブル、符号4dは後述の濃淡振り分け回路の処理で参照するための濃淡振り分けテーブル、符号4eは上述の各種プログラムを格納しているプログラム群をそれぞれ示している。

【0058】また、符号5はROM4中の各種プログラ

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ム実行の際のワークエリアおよびエラー処理時の一時退避エリアとして用いるRAMを示す。そして符号6は後述する画像信号処理を行う処理部を示し、符号7は記録時に画像信号処理部6で処理した画像信号に基いてドット画像を形成するプリンタ部を示している。さらに、符号8は本装置内のアドレス信号、データ、制御信号等を伝送するバスラインを示す。

【0059】(画像信号処理部) 次に、図8に示した画像信号処理部6の詳細について説明する。

【0060】図9は本実施例の画像信号処理部6を構成する回路の一例を示すブロック図である。

【0061】ホスト装置等から転送されるレッド、グリーン、ブルーそれぞれの画像輝度信号R、G、Bは入力ガンマ補正回路11に入力し、ここでシアン、マゼンタ、イエローそれぞれの画像濃度信号21C、21M、21Yに変換される。これら信号は、色補正(マスキング)回路12、黒生成・UCR(下色除去)回路13で色処理が施されて、シアン、マゼンタ、イエロー、ブラックの新たな画像濃度信号23C、23M、23Y、23Kに変換される。

【0062】これらの画像濃度信号は、出力ガンマ補正回路14でガンマ補正が行われた後、濃淡振り分け回路15で染料濃度が高い濃シアン、濃マゼンタ、濃イエロー、濃ブラックの各インクに対応した画像濃度信号25Ck、25Mk、25Yk、25Kkおよび染料濃度が低い、淡シアン、淡マゼンタ、淡イエロー、淡ブラックの各インクに対応した画像濃度信号25Cu、25Mu、25Yu、25Kuに振り分けられる。

【0063】図10(A)、(B)および(C)はそれぞれ濃淡振り分けテーブルの例を説明する線図である。

【0064】例えば、本例のように、濃淡2種の濃度のインクを用いた場合には、図10(B)の変換テーブルが用いられる。

【0065】このテーブルは、画像濃度信号値と記録後の画像の光学反射濃度値とが比例線形関係を示すように設定されている。画像濃度信号は、この濃淡振り分けテーブルをもとに濃淡振り分け回路で濃および淡信号に変換される。濃、淡それぞれに振り分けられた各画像濃度信号は2値化回路6で2値化される。プリンタ部7ではこの2値データを各記録ヘッドの吐出信号とし、各記録ヘッドから信号値に応じて対応するインク吐出口よりインクが吐出されてカラー画像が記録される。

【0066】(プリンタ部) 図11は本発明の実施例におけるカラーインクジェット記録装置の要部構成を示す斜視図である。

【0067】ブラック、シアン、マゼンタ、イエローそれぞれの淡インクを別個に吐出する各吐出口列を有する淡インク用インクジェットユニット40uと、ブラック、シアン、マゼンタ、イエローそれぞれの濃インクを吐出する各吐出口列を有する濃インク用インクジェット

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ユニット40kとがキャリッジ41に互いに所定距離をおいて設置される。キャリッジ41は、ガイドシャフト43により摺動自在に案内指示され、駆動ベルト44を介したキャリッジモータ45の駆動により上記ガイドシャフト43に沿って往復移動させられる。

【0068】インクジェットユニット40u、40kの各記録ヘッドのインク吐出口に連通する液路にはインク吐出に用いられる熱エネルギーを発生する発熱素子(電気熱変換素子)が設けられている。

【0069】各インクジェットユニット40u、40kの対応吐出口列へのインク供給はそれぞれのインクカートリッジ48u、48kから所定の供給路を介して行われる。このインクカートリッジ48u、48kは内部が壁により分割されており、イエロー、マゼンタ、シアン、ブラックのそれぞれの濃度のインクを貯留する。またインクジェットユニット40u、40kへの制御信号等は、フレキシブルケーブル49を介して送られる。

【0070】記録用紙やプラスチック薄板等から成る被記録材は不図示の搬送モータを駆動源とする搬送ローラ(不図示)および排紙ローラ42により、矢印方向に搬送され、この間に各インクジェットユニットの移動に伴なって対向する面に記録がなされて行く。すなわち、キャリッジ41の移動位置を検出するエンコーダの読み取りタイミングに従い、上記発熱素子を記録信号に基づいて駆動し、各色の濃インク色、淡インク色の順に被記録材上にインク液滴を吐出、付着させることで画像を記録することができる。

【0071】キャリッジ41の移動による記録領域外に設定されたキャリッジ41のホームポジションには、キャップ部47をもつ回復ユニット46が配設されている。記録を行わない時には、キャリッジ41をホームポジションへ移動させてキャップ部47の各キャップにより対応するインクジェットユニット40u、40kのインク吐出口形成面を密閉し、インク溶剤蒸発に起因するインクの固着あるいは塵埃等の異物の付着等による目詰まりを防止する。

【0072】また、上記キャップ部47は、記録頻度の低いインク吐出口の吐出不良や目詰まりを解消するためキャップ部内へインクを吐出させる空吐出モードを行うときやインク吐出口からインクを吸引し、吐出不良を起こしたインク吐出口の吐出回復を行う際に利用される。またキャップ部隣接位置にブレードを配設することにより、インクジェットユニットのインク吐出口形成面をクリーニングすることも可能である。

【0073】なお、キャップ47の上下方向における各境界に仕切りを設けることにより上側で吸引等されたインクが下側へ移行するのを防ぎ、これにより混色による画質劣化等を防止することができる。

【0074】(インクジェットユニット) 図12は本実施例に用いるインクジェットユニット40uまたは40

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kの構成を示す分解斜視図である。

【0075】配線基盤50の一端はヒーターボード51の配線部分と相互に接続され、さらに配線基盤50の他端部には、本装置制御部からの制御信号、吐出信号等を受けるための複数個のパッドが設けられている。これにより本体装置制御部からの電気信号は、それぞれの電気熱変換素子に供給されるようになる。

【0076】配線基盤50の裏面を平面で支持する金属製の支持板52は、インクジェットユニットの底板をもなす。押さえね53は溝付天板54のインク吐出口近傍の領域を線状でかつ弾性的に押圧するものであり、そのために断面が略U字形状の折り曲げ形成した部分と、ベースプレートに設けた逃げ穴を利用して引っかける爪と、バネに作用する力をベースプレートで受ける一対の後脚を有している。このバネ力により配線基盤50と溝付天板54とを圧接している。また、支持体に対する配線基盤50の取付けは、接着剤等による貼着で行われる。

【0077】インク供給管55は、イエロー、マゼンタ、シアン、ブラックの各インクに対応して4つ設けられている。インク供給管55の端部にはフィルター56が設けられている。インク供給部材57は、モールド成形で製造され、供給管55から溝付天板54の各インク供給口へと導く流路が形成されている。インク供給部材57の支持板52に対する固定は、インク供給部材57の裏面側の2本のピン(不図示)を支持体52の穴58、59にそれぞれ貫通突出させ、これを熱融着することにより簡単に行われる。

【0078】この際、オリフィスプレート部580と供給部材57との隙間は均一に形成される。封止剤はインク供給部材57の上部封止剤注入口から注入され、ワイヤーボンディングを封止すると同時にオリフィスプレート部580とインク供給部材57との隙間を封止し、さらに支持板52に設けられた溝を通り、オリフィスプレート部580と支持板52前端部との隙間を完全に封止する。

【0079】図13は、上述した溝付天板54をヒーターボード51側から見た斜視図である。

【0080】共通液室用溝が、イエロー、マゼンタ、シアン、ブラックの各インク用に4個設けられており、各共通液室は壁60a～60cで仕切られ、各共通液室にはインク供給のための供給口61a～61dが設けられている。

【0081】これら各共通液室を仕切る壁60a～60cにおけるヒーターボード51との圧接面には溝62a～62cを設けてある。この溝は、溝付天板54の外周部と連通している。溝付天板54をヒーターボードに圧接し密着させた後、外周部は、前述したように封止剤で封止される。この際、上記溝に沿って、封止剤が浸透していく、溝とヒーターボードの隙間を埋めていく。このよ

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うに、従来の記録ヘッドで用いられていたのと同様の工程で、共通液室を完全に分離することができる。この溝の構造は封止剤の物性により異なり、それぞれに対応した形状にする必要がある。

【0082】このように、共通液室を複数に分離することにより、各インク吐出口に異なったインクを供給することが可能となる。

【0083】図14(A)は、インクジェットユニット40u、40kのインク吐出口列を被記録材側から見た模式図である。

【0084】本例では、上述したように、イエロー、マゼンタ、シアン、ブラックの各インク吐出口列を一体に有したそれぞれ濃インク用、淡インク用、2つのインクジェットユニット40u、40kを用いる。

【0085】インクジェットユニット40kの、70Yk、70Mk、70Ck、70Kkはイエロー、マゼンタ、シアン、ブラックそれぞれの濃インクを吐出する吐出口列を示す。

【0086】インクジェットユニット40uの、71Yu、71Mu、71Cu、71Kuはイエロー、マゼンタ、シアン、ブラックそれぞれの淡インクを吐出する吐出口列を示す。各色の吐出口列は1インチあたり360ドット(360dpi)のピッチで32個の吐出口を有し、これら吐出口列の各色間は共通液室間の壁により8ドット分のスペースがある。

【0087】図15は、図14(A)に示すインクジェットユニットを用いた画像形成過程を示す模式図である。

【0088】以下の説明では各色間のスペースは無いものとして説明する。

【0089】第N+1行に着目すると、第1走査で濃ブラックKk、淡ブラックKuによる記録が行われた後、所定量の被記録材の搬送動作(ラインフィード、以下LFと略す)が行われ、第2走査で濃シアンCk、淡シアンCuによる記録とLFが行われ、第3走査で濃マゼンタMk、淡マゼンタMuによる記録とLFが行われ、第4走査で濃イエローYk、淡イエローYuによる記録とLFが行われ、第N+1行の記録が完成する。各走査記録後のLF量は各色の吐出口列の32個の吐出口配列長さ分(実際はスペース分を加えた長さ)であり4回の走査記録により32吐出口分の画像が記録される。

【0090】図14(B)は、インクジェットユニット40u、40kの他の例を示す図である。

【0091】本例では同一インクジェットユニット内に濃マゼンタ、濃シアン、濃ブラックの各インク吐出口列を有するものと淡マゼンタ、淡シアン、濃イエローの各インク吐出口列を有するものを用いる。

【0092】図14(B)においてインクジェットユニット40kの、72Kk、72Mk、72Ckは、ブラック、マゼンタ、シアンそれぞれの濃インクを吐出する

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吐出口列を示す。また、インクジェットユニット40uの、73Yk, 73Mk, 73Cuは、イエロー、マゼンタ、シアンそれぞれの淡インクを吐出する吐出口列を示す。

【0093】この構成では、明度が高いため画像明部でそれ程ドットの粒状性が目立たないイエローインクや、画像の高濃度部でのみ使用されるため粒状性がそれ程目立たないブラックインクは濃インクのみ使用するようになる。

【0094】本構成の場合、濃淡振り分けテーブルは、イエロー、ブラックは図10(A)、マゼンタ、シアンは図10(B)を使用する。また、72Kk, 73Ykの吐出口数は他色の吐出口数の倍有している。各色の吐出口列は1インチあたり360ドット(360dpi)のピッチで濃、淡マゼンタ、濃、淡シアン用は32個の吐出口を有し、濃ブラック、濃イエロー用は64個の吐出口を有している。また、各色間は液室の壁により8吐出口分のスペースがある。

【0095】図16は、図14(B)に示す本構成の記録ヘッドを用いた場合の画像形成過程を示す模式図である。

【0096】第N+1行に着目すると、第2走査で濃ブラックKkと濃イエローYkによる記録とLFが行われ、第3走査で濃シアンCk、淡シアンCuによる記録とLFが行われ、第4走査で濃マゼンタMk、淡マゼンタMuによる記録とLFが行われ、第N+1行の記録が完成する。各走査記録後のLF量は32吐出口列幅分であり3回の走査記録により32吐出口列分の画像記録が行われる。

【0097】なお、濃イエローと濃ブラックの記録は1走査おきに行われ、マゼンタ、シアンに比べ倍の64吐出口分の記録を1度に行う。

【0098】本構成のようになると、黒文字、モノクロ記録を行う場合LF量を64ドット幅分に可変することで記録速度を速くすることが出来る利点がある。

【0099】図14(C)は、インクジェットユニットのさらに他の構成例を示す図である。

【0100】本例では、同一インクジェットユニット内にイエロー、マゼンタ、シアン、ブラックの各インク吐出口列を有したものを濃インク用、淡インク用、2つのインクジェットユニットを使用している。ただしイエロー、ブラックは両インクジェットユニットとも濃インクを使用している。

【0101】図14(C)において、インクジェットユニット40kの、74Yk, 74Kk, 74Mk, 74Ckは、イエロー、ブラック、マゼンタ、シアンそれぞれの濃インクを吐出する吐出口列である。

【0102】インクジェットユニット40uの、75Mk, 75Ckはマゼンタ、シアンそれぞれの淡インクを吐出する吐出口列75Kk, 75Ykはブラック、イエ

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ローそれぞれの濃インクを吐出する吐出口列である。

【0103】先に述べた構成と同様に、明度が高いため画像明部でドットの粒状性が目立たないイエローインクや画像の高濃度部でのみ使用されるため粒状性が目立たないブラックインクは濃インクのみ使用する。

【0104】本構成では、濃淡振り分けテーブルとして、イエロー、ブラックについては図10(A)、マゼンタ、シアンは図10(B)を用いる。

【0105】各色の吐出口列は1インチあたり360ドット(360dpi)のピッチで32個の吐出口を有し各色間は液室の壁により8ドット分のスペースがある。ブラック、イエロー用の吐出口列は2つのインクジェットユニットを用いることで他色の吐出口数の倍有しており、64ドット分の記録を同時にできる。また、イエロー、ブラック間はブランクが生じないように吐出口列がずらして形成されている。

【0106】図17は図14(C)に示す構成のインクジェットユニットを用いた場合の画像形成過程を示す模式図である。

【0107】第N+1行に着目すると、第2走査目で濃ブラックKkと濃イエローYkによる記録とLFが行われ、第3走査目で濃シアンCk、淡シアンCuによる記録とLFが行われ、第4走査目で濃マゼンタMk、淡マゼンタMuによる記録とLFが行われ、3回の走査記録により画像が完成する。各走査記録後のLF量は32吐出口列幅分であり3回の走査記録により32吐出口列幅分の画像が記録される。

【0108】濃イエローと濃ブラックの記録は、図に示す例では、第2走査と第4走査の1走査おきに行われ、マゼンタ、シアンにくらべ2つのインクジェットユニットの吐出口列を用いることで倍の64ドット分の記録を1度に行うことができる。

【0109】本構成のようになると、先の構成と同様に黒文字、モノクロ印字を行う場合、LF量を64ドット幅分に可変することで記録速度を速くすることが可能である。

【0110】上記いずれの構成例においても、記録過程において一度に全色の記録を行わないため、滲み等による画像劣化も少なく良好な画像が得られる。さらに、実際のインクジェットユニットにおいては、各色間にスペースがあるため、各色の記録走査のつなぎ位置は本図説明のように各色で一致せず、異なった位置となり結果として記録走査のつなぎ筋の発生を緩和させる効果も得られる。

【0111】本実施例のように液室を分割し、同一吐出口形成面に異なる色のインクを吐出するインク吐出口を備えたインクジェットユニットを用いることで、インクジェットユニット(記録ヘッド)の数、インクカートリッジの数を減らすことができ、装置の小型化が可能となる。

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【0112】また、本実施例に用いたインクジェットユニットは同一吐出口面に異なる色の吐出口列を精度良くかつ廉価に製造することができるため従来装置のような高い精度や複雑な補正制御が不要となり低価格化も可能となる。

【0113】なお、本実施例のインクジェットユニットはインク吐出タイミング補正の低減化から各色吐出口列が同一直線上に配列した方が好ましいが、本実施例に限定されることなく各色吐出口列を横並びに配列したり、千鳥状に配列したりしても良い。

【0114】また、本実施例で説明したように、必要に応じて吐出口の数を色毎に変えることで、記録速度の向上も可能となる。

【0115】さらに、本実施例のインクカートリッジはインクジェットユニットと同様にキャリッジ上に搭載されているが、インクジェットユニットと一体化しても良く、またキャリッジ上には搭載せずにインク供給キューブを介してインクジェットユニットにインクを供給するようにしても良い。また本実施例のように内部を分割して複数色のインクを有するカートリッジを用いた方が装置小型化の面で好ましいが、内部を分割せずに単一色のインクカートリッジを用いるようにしても良い。

【0116】実施例1の変形例1

(プリンタ部) 図18は上記実施例1の変形例1におけるカラーインクジェット記録装置の要部構成を示す斜視図である。図11に示した要素と同様の要素には、同一の符号を付してその説明を省略する。以下で示す図19、図20においても同様とする。

【0117】本例の場合、濃ブラックインクを吐出する吐出口列、淡ブラックインクを吐出する吐出口列を有するブラックインク用インクジェットユニット110Kと、濃シアンインクを吐出する吐出口列、淡シアンインクを吐出する吐出口列を有するシアンインク用インクジェットユニット110Cと、濃マゼンタインクを吐出する吐出口列、淡マゼンタインクを吐出する吐出口列を有するマゼンタインク用インクジェットユニット110Mと、濃イエローインクを吐出する吐出口列、淡イエローインクを吐出する吐出口列を有するイエローインク用インクジェットユニット110Yとはキャリッジ41に所定距離をおいて記録走査方向に設置される。

【0118】(インクジェットユニット) 図19は本例に用いるインクジェットユニット110K、110C、110M、110Yの構成を示す分解斜視図であり、溝付天板54以外、図12に示す構成とほぼ同様である。

【0119】図20は、本例に用いるインクジェットユニットの溝付天板54をヒーターボード121側から見た斜視図である。本実施例の共通液室は濃インク用、淡インク用に2個設けられており、各液室は壁60で仕切られている。各共通液室にはインクが供給されるための供給口61a、61bが設けられている。

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【0120】図21は、上記インクジェットユニットのインク吐出口列を被記録材側から見た図である。本例では同一インクジェットユニット内に濃インク用、淡インク用の各インク吐出口列を有し、イエロー、マゼンタ、シアン、ブラックのインクに対応してそれぞれインクジェットユニットを用いる。

【0121】図21において、143Yu、142Mu、141Cu、140Kuは淡インクを吐出する吐出口列、143Yk、142Mk、141Ck、140Kkは濃インクを吐出する吐出口列である。

【0122】各濃淡インクに対応した吐出口列は1インチあたり360ドット(360dpi)のピッチで64個の吐出口を有し各色間は共通液室の壁により8吐出口分のスペースがある。

【0123】図25は図21に示すインクジェットユニットを用いた場合の画像形成過程を示す模式図である。

【0124】第N+1行に着目すると、第1走査で濃ブラック、濃シアン、濃マゼンタ、濃イエローによる記録とLFが行われ、第2走査で淡ブラック、淡シアン、淡マゼンタ、淡イエローによる記録とLFが行われ、2回の走査記録により第N+1行の記録が完成する。各走査記録後のLF量は64吐出口列分であり、2回の走査記録により64吐出口列分の画像が記録される。

【0125】図22は、インクジェットユニットの他の構成例を示す模式図である。

【0126】本例では同一インクジェットユニット内に濃インク用、中濃度インク用、淡インク用の各インク吐出口列を有し、イエロー、マゼンタ、シアン、ブラックの各インクに対応してそれぞれのインクジェットユニットを用いている。本構成の場合、濃淡振り分けテーブルは図10(C)に示すものを用いる。

【0127】図22において、それぞれ153Yu、152Mu、151Cu、150Kuは淡インクを吐出する吐出口列、153Ym、152Mm、151Cm、150Kmは中濃度インクを吐出する吐出口列、153Yk、152Mk、151Ck、150Kkは濃インクを吐出する吐出口列である。

【0128】各濃、中、淡インクに対応した吐出口列は1インチあたり360ドット(360dpi)のピッチで64個の吐出口を有し各色間は共通液室の壁により8ドット分のスペースがある。

【0129】本例の場合は、第1走査で濃ブラック、濃シアン、濃マゼンタ、濃イエローによる記録とLFが行われ、第2走査で中ブラック、中シアン、中マゼンタ、中イエローによる記録とLFが行われ、第3走査で淡ブラック、淡シアン、淡マゼンタ、淡イエローによる記録とLFが行われ、3回の走査記録により画像が完成する。各記録走査後のLF量は32吐出口列分であり、3回の走査記録により32吐出口列分の画像が記録される。

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【0130】本構成のように濃淡インクに加え、中濃度インクを用いることで全階調領域で粒状感が目立たなくなり、さらに各濃度インクの切り替えをスムーズに行うことができ、疑似輪郭の発生も防止でき、さらに滑らかな階調再現が可能となる。

【0131】図23は、インクジェットユニットのさらに他の構成例を示す模式図である。

【0132】本例では同一インクジェットユニット内に濃インク用、淡インク用の各インク吐出口列を有したものと、單一色のインク吐出口を有したものを組み合わせて使用している。

【0133】図23において、それぞれ162Mu, 161Cuは淡インクを吐出する吐出口列、163Yk, 162Mk, 161Ck, 160Kkは濃インクを吐出する吐出口列である。吐出口列160Kk, 163Ykの吐出口数は他色の吐出口列の吐出口数の倍である。

【0134】明度が高いため画像明部でもドットの粒状性が目立たないイエローインクや、画像の濃度部でのみ使用されるため粒状性が目立たないブラックインクについては濃インクのみ使用する。本構成の場合、濃淡振り分けテーブルはイエロー、ブラックについては図10

(A)、マゼンタ、シアンについては図10 (B)に示すものを用いる。

【0135】図26は図23に示すインクジェットユニットを用いた場合の画像形成過程を示す模式図である。

【0136】同図において、第N+2行に着目すると、第2走査で濃ブラック、濃シアン、濃マゼンタ、濃イエローによる記録とLFが行われ、第3走査で淡シアン、淡マゼンタによる記録とLFが行われ、2回の走査記録により画像が完成する。各走査記録後のLF量は64吐出口列分であり2回の走査記録により64吐出口列分の画像記録を行うことができる。

【0137】濃イエローと濃ブラックの記録は図中、第2走査のみで、1走査おきに行われ、マゼンタ、シアンと比較して倍の128吐出口列分の記録を1度に行う。

【0138】本構成のようにすることで、前述の実施例同様に黒文字、モノクロ印字を行う場合LF量を128ドット幅分に可変とすることで記録速度を向上させることができる。

【0139】図24は、インクジェットユニットのさらに他の構成例を示す模式図である。

【0140】本例では同一インクジェットユニット内に濃インク用、淡インク用の各インク吐出口列を有しが、インク吐出量が異なる吐出口列を有するユニットを用いている。

【0141】図24において、173Yus, 172Mus, 171Cus, 170Kusは、それぞれの色の淡インクの小液滴を吐出する吐出口列、173Yul, 172Mul, 171Cul, 170Kulは、それぞれの色の淡インクの大液滴を吐出する吐出口列である。

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【0142】173Yks, 172Mks, 171Cks, 170Kksは、それぞれの色の濃インクの小液滴を吐出する吐出口列、173Ykl, 172Mkl, 171Ckl, 170Kklは、それぞれの色の濃インクの大液滴を吐出する吐出口列である。

【0143】小液滴のインク液滴量は約20plであり、大液滴のインク液滴量は約40plである。

【0144】図27は、図24に示すインクジェットユニットを用いた場合の画像形成過程を示す模式図である。

【0145】第N+1行に着目すると、第1走査で濃ブラック、濃シアン、濃マゼンタ、濃イエローの小液滴による記録とLFが行われ、第2走査で濃ブラック、濃シアン、濃マゼンタ、濃イエローの大液滴による記録とLFが行われ、第3走査で淡ブラック、淡シアン、淡マゼンタ、淡イエローの小液滴による記録とLFが行われ、第4走査で淡ブラック、淡シアン、淡マゼンタ、淡イエローの大液滴による記録とLFが行われ、4回の走査記録により第N+1行の記録が完成する。各走査記録後のLF量は32吐出口列分であり、4回の記録走査で32吐出口列分の画像記録が行える。

【0146】本構成のように濃、淡インクに加え、ドット径が大小異なるものを組み合わせて記録を行うことで、全階調領域で粒状感を自立なくなり、さらに各濃度インクの切り替えがスムーズに行うことができ、疑似輪郭の発生も防止でき、さらに滑らかな階調再現が可能となる。

【0147】上記いずれの構成においても、前述の実施例同様、一度に全色の記録を行わないため、滲み等による画像劣化も少なく良好な画像が得られる。さらに、実際のインクジェットユニットにおいては、各色の吐出口列間にスペースがあるため、各色の記録走査のつなぎ位置は本図説明のように各色一致せず、異なった位置となり結果として記録走査のつなぎ筋の発生を緩和させる効果も得られる。

【0148】また本変形例で説明した構成によれば同色系のインクは一つのインクジェットユニット内にまとめることができ、インクカートリッジの共有化、吐出回復動作時に発生しやすい混色の緩和にも効果がある。特に濃度の低いインク(淡インク)の吐出口列を上側に濃度の高いインク(濃インク)を下側に配列することで吐出回復動作での吸引動作でインク垂れ込みが生じても、インク混色を防止できる。

【0149】本変形例も先の実施例同様に、共通液室を分割し、同一吐出口形成面に異なる色のインクを吐出するインク吐出口を一体に備えたインクジェットユニットを用いることで、インクジェットユニット(記録ヘッド)の数、インクカートリッジの数を減らすことができ、装置の小型化が可能となる。また本実施例に用いたインクジェットユニットも、同一吐出口面に異なる色の

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吐出口列を精度良くかつ廉価に形成することができるため従来装置のような高い精度や複雑な補正制御が不要となり低価格化も可能となる。

【0150】なお、本実施例のインクジェットユニットにおいても、インク吐出タイミング補正の低減化から各色吐出口列が同一直線上に配列した方が好ましいが、本実施例に限定されることなく各色吐出口列を横並びに配列したり、千鳥状に配列したりしても良い。

【0151】また、本変形例で説明したように、必要に応じて吐出口の数を色毎に変えることで、記録速度の向上も可能となる。

【0152】さらに、本変形例のインクカートリッジはインクジェットユニットと同様にキャリッジ上に搭載されているが、インクジェットユニットと一体化しても良く、またキャリッジ上には搭載せずにインク供給チューブを介してインクジェットユニットにインクを供給するようにしても良い。また本実施例のように内部を分割して複数色のインクを有するカートリッジを用いた方が装置小型化の面で好ましいが、内部を分割せずに単一色のインクカートリッジを用いるようにしても良い。

【0153】実施例1の変形例2

図28は、実施例1の他の変形例にかかるインクジェットユニットを被記録材側から見た模式図である。

【0154】本例のインクジェットユニットは記録に使用する全インク色に対応するインク吐出口列をすべて同一インクジェットユニット内に一体に設ける。インクジェットユニット210において、210Yuは淡イエローの色インクを吐出する吐出口列、210Muは淡マゼンタの色インクを吐出する吐出口列、210Cuは淡シアンの色インクを吐出する吐出口列、210Kuは淡ブラックの色インクを吐出する吐出口列、210Ykは濃イエローの色インクを吐出する吐出口列、210Mkは濃マゼンタの色インクを吐出する吐出口列、210Ckは濃シアンの色インクを吐出する吐出口列、210Kkは濃ブラックの色インクを吐出する吐出口列である。各色インク吐出口列は1インチあたり360ドット(360dpi)のピッチで32個の吐出口をもち各色の吐出口列間は共通液室の壁により8ドット分のスペースがある。

【0155】第1走査で濃ブラックによる記録とLFが行われ、第2走査で淡ブラックによる記録とLFが行われ、第3走査で濃シアンによる記録とLFが行われ、第4走査で淡シアンによる記録とLFが行われ、第5走査で濃マゼンタによる記録とLFが行われ、第6走査で淡マゼンタによる記録とLFが行われ、第7走査で濃イエローによる記録とLFが行われ、第8走査で淡イエローによる記録とLFが行われ、8回の走査記録により各行の記録が完成する。各走査記録後のLF量は32吐出口列分であり8回の記録走査により32吐出口列分の画像記録を行うことができる。

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【0156】本構成においても、先の実施例同様、一度に全色の記録を行わないため滲み等による画像劣化も少なく良好な画像が得られる。さらに、実際のインクジェットユニットにおいては、各色間にスペースがあるため、各色の記録走査のつなぎ位置は本図説明のように各色一致せず、異なった位置となり結果として記録走査のつなぎ筋の発生を緩和させる効果も得られる。

【0157】本実施例のインクジェットユニットは全色のインク吐出口列が同一吐出口形成面に精度良くつくることが可能であり、各色間のレジストレーションずれの問題がない。

【0158】また、各色間の吐出タイミングを補正する必要がないため本実施例のように全色同一直線上に配列した方が好ましいが、本実施例に限定されることなく各色吐出列を横並びに配置したり、千鳥状に配列しても良い。

【0159】また必要に応じて吐出口の数を色毎に変えることで、記録速度の向上も可能となる。

【0160】本実施例も先の各実施例同様に、共通液室を分割し、同一吐出口形成面に異なる色のインクを吐出するインク吐出口を備えたインクジェットユニットを用いることで、インクジェットユニット(記録ヘッド)の数、インクカートリッジの数を減らすことができ、装置の小型化が可能となる。また従来装置のような高度な装置精度や複雑な補正制御が不要となり低価格化も可能である。

【0161】さらインクカートリッジはインクジェットユニットと同様にキャリッジ上に搭載することが好ましいが、インクジェットユニットと一体化しても良く、またキャリッジ上には搭載せずにインク供給チューブを介してインクジェットユニットにインクを供給するようにしても良い。また内部を分割して複数色のインクを有するカートリッジを用いた方が装置小型化の面で好ましいが、内部を分割せずに単一色のインクカートリッジを用いるようにしても良い。

【0162】実施例1の変形例3
図29はイエロー、マゼンタ、シアン、ブラック各4色のインクジェットユニット224をフレーム220により一体的に組み立てた一体型インクジェットカートリッジの構造を示している。

【0163】インクジェットユニット224の構成は先の実施例で詳細に説明しているのでここでは説明を省略する。

【0164】4つのインクジェットユニット224はフレーム220内に所定の間隔で取り付けられ、しかも吐出口列方向のレジストレーションも調整された状態で固定される。221はフレームのカバーであり、222は4つのインクジェットユニット224の配線基盤120に設けられたパッドと本体装置からの電気信号をつなぐためのコネクタである。配線基盤120とコネクタ22

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2は電極223により接続されている。

【0165】図30は上記一体型インクジェットカートリッジ222をキャリッジに搭載したときの様子を示したものである。

【0166】インクタンク118は仕切り230により上下2つの部屋に仕切られており、上の部屋に淡インクを下の部屋には濃インクを充填してある。そしてキャリッジ上でインクジェットカートリッジ222とイエロー、マゼンタ、シアン、ブラックの4つのインクタンク118とが圧接結合されインクタンク118より対応するインク吐出口列へインクが供給される。

【0167】本構成のインクジェットユニットにおいても、先の各実施例同様、一度に全色の記録を行わないため滲み等による画像劣化も少なく良好な画像が得られる。さらに、実際のインクジェットユニットにおいては、各色吐出口列間にスペースがあるため、各色の記録走査のつなぎ位置は各色一致せず、異なった位置となり結果として記録走査のつなぎ筋の発生を緩和させる効果も得られる。

【0168】本実施例の一体インクジェットカートリッジは複数のインク吐出口列が同一吐出口形成面に精度良くつくられたインクジェットユニットを、精度良く並べ一体カートリッジに組上げることが可能であり、各インクジェットユニット間のレジストレーションずれの問題が解決でき、補正制御の負荷が低減する。また各インクジェットユニットの電気接点部を共通化することが可能であり装置本体との接点数を減らすことができる。

【0169】それぞれインクジェットユニット内の各吐出口列は各色間の吐出タイミングを補正する必要がないため全色同一直線上に配列した方が好ましいが、本実施例に限定されることなく各色吐出列を横並びに配置したり、千鳥状に配列しても良い。

【0170】また、必要に応じて吐出口の数を色毎に変えることで、記録速度の向上も可能となる。

【0171】さらに、インクカートリッジはインクジェットカートリッジと同様にキャリッジ上に搭載することが好ましいが、インクジェットカートリッジと一体化しても良く、またキャリッジ上には搭載せずにインク供給キューブを介してインクジェットカートリッジにインクを供給するようにしても良い。また内部を分割して複数色のインクを有するカートリッジを用いた方が装置小型化の面で好ましいが、内部を分割せずに単一色のインクカートリッジを用いるようにしても良い。

【0172】加えて、本実施例も先の実施例同様に、装置の小型化が可能であり、また従来装置のような高度な装置精度や複雑な補正制御が不要となり低価格化も可能である。

【0173】実施例1の変形例4

本例では、各記録走査で記録される画素位置を縦1×横2画素の画素群を互い違いになる様に配置する。

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【0174】以下、図31を参照して本例の記録を説明する。第1記録走査ではインク吐出口列の全16個の吐出口の内、淡インク部分の下半分4つの吐出口を使う。この時、記録する画素配列は、1×2画素を互い違いにしたもので上記吐出口が記録できる全画素の半分を記録する（画素を半分に間引いて記録する）。第1記録走査終了後、記録紙は4画素幅だけ矢印方向に送られるとともに、記録ヘッドユニットは、その復動作で記録開始位置に戻される。

10 【0175】次の第2記録走査では淡インクの全8個の吐出口を使って記録が行われる。この時、記録される画素は、第1記録走査で記録されなかった4画素幅の領域と、これに続く4画素幅の画像領域の内、同様に1×2画素を互い違いに配列した部分である（第1記録走査時と逆の間引きを行う）。

【0176】再び4画素幅の紙送りを行い、記録ヘッドを記録開始位置へ戻した後、第3記録走査が行われる。ここで使用される吐出口は、淡インク全8個の吐出口と、濃インク吐出口列の内、下半分4つの吐出口である。

20 この時記録される画素配列は、第1記録走査時と同様な1×2画素を互い違いにしたもので上記吐出口が記録できる全画素の半分を記録する（画素を半分に間引いて記録する）。

【0177】次の第4記録走査ではじめて記録ヘッドユニットの全吐出口が使用される。第3記録走査と逆の間引きで1×2画素を互い違いに配列した画素の記録を行う。

【0178】そして、この記録走査により第1画素記録への記録はすべて完了する。

30 【0179】以下、同様にして記録を繰返すことで画像を完成させる。

【0180】上述のような分割記録方法を用いることで吐出特性のばらつきによる濃度むらや記録媒体搬送むらによる黒すじ、白すじを緩和させることができ良好な画像を提供できる。

【0181】上述実施例では、1×2画素を互い違いにした間引きパターンを用いたがこれに限定されることなく千鳥状の間引きパターンを用いても良い。

40 【0182】さらに、記録ヘッドユニットの構成は本例に限られず、上記、各実施例で説明したあらゆる構成のものに応用できる。

【0183】なお、上記すべての実施例はカラー画像記録のみならずグレースケール記録のような単色画像に対しても有効な手段である。

【0184】以上説明した実施例1およびその変形例によれば上述した種々の効果に加え、以下のような効果を得ることもできる。

50 【0185】上記各実施例で示したように、同一のインクジェットユニット内に、異なる種類のインク、すなわち、Y, M, C, Kのインクを吐出する吐出口、あるいは

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は同種インクについて濃、淡インクをそれぞれ吐出する吐出口を設けることができるので、各色の記録ドット間または各濃淡の記録ドット間でのレジ合せが容易になる。

【0186】また、上述したような濃、淡各インクを吐出する吐出口を同一のインクジェットユニット内に設ける構成にあっては、これら同一系色の濃淡インクの使用頻度はほぼ等しいので、インクタンクを一体としたインクジェットユニットの交換を、インクをそれ程無駄にすることなく行うことができる。

【0187】以下に示す実施例2およびその変形例は、実施例1およびその変形例で示した各インクの吐出口配列の関係を利用して、カラー記録の際の色むら、濃淡むら、スジ等を十分に低減するものである。

【0188】従って、以下の実施例では、実施例1およびその変形例による、各インクの吐出口列の一体化による効果を奏するインクジェットユニットを用いることでもできるし、あるいは、各インクの吐出口配列の関係のみが実施例1等と同様で、各吐出口列が一体化されない構成も用いることができる。

【0189】なお、以下で示す実施例では、装置構成および制御構成は、実施例1あるいはその変形例で示したものとすることができる。

【0190】実施例2

図32は本発明の実施例2に用いるインクジェットユニット（以下では、記録ヘッドともいう）の構成を示す模式図である。

【0191】本実施例ではブラック（K）、シアン（C）、マゼンタ（M）、イエロー（Y）の各4色の独立した記録ヘッドはそれぞれ濃インク吐出用の8吐出口と淡インク吐出用の8吐出口の計16吐出口を有している。この記録ヘッドの各インクの吐出口配置は、図21に示す吐出口配置と同様であり、各吐出口列を一体とすることができる。

【0192】図中矢印で示す方向に記録ヘッドの記録走査と紙送りがなされ、紙送りについては各記録走査毎に4吐出口分の幅で行われる。本実施例の構成によれば、淡インク記録領域から濃インク記録領域に向かって記録紙が送られるので、記録は常に淡インク画像が完了した後に濃インク画像が記録される。このように、紙送り方向に濃、淡各インクの吐出口列を1列に並べる構成にすれば、両方向記録の往路と復路で濃、淡各インクの打ち込み順が逆転するがないので、インクの打ち込み順に起因した濃淡むらを予め防ぐことができる。

【0193】本実施例においては、色の異なる複数種類のインクのそれぞれについてさらに濃度の異なるインクを吐出する記録ヘッドを用いて分割記録することを特徴としているので、図7に示したような全種類のインクの吐出口列が記録走査方向に配列している構成においても、分割記録の効果は発揮できる。ただし、このような

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構成では未だ完全には色むら弊害は解決されないことが多い。

【0194】この理由を図33（A）および（B）を用いて以下に説明する。

【0195】通常インクドップレットの量は、紙面上の各画素に与えられた面積よりも多少大きく広がるように設計されている。これは印字率100%の領域に対し、白紙の部分が見えないようにするためである。従って分割記録法を行った時も、記録画素の数の約50%しか記録されていないが、被記録媒体（記録紙）は図32（A）に示すように、50%以上の領域が覆われていることになる。これに加えて、濃インクと淡インクが、さらには混色記録のために2色以上の、濃インクと淡インクが同一画素に記録されると、1画素当たりに打ち込まれるインク量は4倍に増え、滲み出し領域は殆ど100%に近い状態になってしまい（図32（B））。このため、間引かれた画素にインクドットを記録しても、その部分は最初のドットが既に占めているので後のインクの色の濃度はそれほど高くならない。従って、両方行記録を分割記録で行った場合でも、最初に紙面に記録される時の走査方向の色調、濃度が記録領域全体で優先色となり、往路記録が最初の記録となる画像領域と、復路印字が最初の記録となる画像領域が交互に色むらとなって現れ、これが画像を著しく劣化させてしまうことが多い。

【0196】本実施例において、一様なグリーン画像を記録する状態を図34に示す。

【0197】ここで言う一様なグリーン画像とは、シアン、イエローともに濃インクと淡インクの両方を記録する画像のことで、図10（B）に示す振り分けテーブルにおいては入力画像濃度信号が128から255の間のデューティーを指す。ただし、本実施例を含む以下の詳細において、説明の都合上あらゆる画素に上記4種のインクが記録される状態を設定した。

【0198】本実施例では各記録走査で記録される画素位置は縦1×横2画素の画素群を互い違いになるように配置してある。このようにすることにより、図33で示した1画素単位を互い違いにする配置よりも、各記録走査での記録画素以外への滲み出しを減少させることができるので、既に説明した打ち込み順による色むらが起こり難くなる。

【0199】以下、図34において各記録走査毎に簡単に説明していく。

【0200】第1記録走査では記録ヘッド内の全16吐出口の内、淡インク部分の下半分の4吐出口を用いる。この時記録する画素配列は、1×2画素を互い違いにしたもので、上記吐出口が記録できる全画素の半分を記録する。第1記録走査では記録ヘッドが往路方向に走査しながら記録するので、一様なグリーン画像を記録する場合は、各記録画素ヘシアン、イエローの順にインクが打ち込まれていく。従って第1記録走査で記録された画素

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では、シアンの発色が強いグリーン画像が得られることとなる。第1記録走査終了後、記録紙は4画素幅だけ図中矢印の方向に送られる。

【0201】次の第2記録走査では、復路方向に淡インクの全8吐出口を用いて記録される。この時記録される画素は、第1記録走査で記録されなかった4画素幅の領域と、これに続く4画素幅の画像領域の内、同様に1×2画素を互い違いにした配列の部分である。第2記録走査では、復路方向で記録されるので、記録画素へのインク着弾はイエロー、シアンの順になる。従って、第2記録走査で記録される画素ではイエローの発色が強いグリーン画像となる。しかし、第1および第2記録走査で記録するインクは元々濃度の薄いものであるので、インク打ち込み順による発色性の差はさほど大きく現れるものでは無い。

【0202】再び、4画素幅の紙送りの後、往路方向で第3記録走査が行われる。ここで使用される吐出口は、淡インク全8吐出口および、濃インク吐出口の内、下半分の4吐出口である。この記録走査は再び往路方向の記録なので、第2および第3画像領域の淡インク領域では、シアン、イエローの順のインク打ち込み順で、シアンの発色が強いグリーン画素が得られることとなる。これに対し、第1画像領域では既に、淡インクによる印字が成され、既に優先色が淡インクにより決定されてしまっているので、濃インクがシアン、イエローの順に打ち込まれても、これによる優先色の決定は無く全体的にグリーンの濃度が高くなるのみである。

【0203】次の、第4記録走査で、第1画像領域に対して初めて記録ヘッドの全吐出口が使用される。この記録走査は再び復路走査であるので、イエロー、シアンの順にインクが打ち込まれる。第3記録走査で説明したように、第1画像領域、および第2画像領域では既に淡インクが着弾されている上への記録であるので、濃インクのインク打ち込み順は殆ど画像に影響せず、両画像領域ともグリーンの濃度が全体的に高くなるのみである。そしてこの記録走査により、第1画像領域への記録は全て完了する。第3、および第4画像領域についてはこれまでの記録走査と同様に、インクの打ち込み順によって記録画素での優先色が決定されている。

【0204】以下同様にして、各記録走査では、全16吐出口を用いて、4吐出口列の紙送り走査と往復記録を順次繰り返して行く。

【0205】以上説明してきた方法によれば、図32に示すような記録ヘッドを用いることにより、4画素幅づつ連なる全画像領域に、最初の2走査で淡インク画像を完成させてしまってから、続く2走査で濃インク画像を完成させていく。従って、濃淡インクを用いて記録する方法でも、従来例のような濃淡むらが現れる要因自体が、本実施例では既に取り除かれることになる。

【0206】一方、インク打ち込み順によるもう一つの

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弊害の色むらについては、往路と復路で異なる色調のドットを記録してしまう構成になっている。しかし、本実施例では分割記録を行い、かつ同時に記録する画素を1×2単位としているので、従来例で説明した図33の場合よりもさらに他領域への滲み出しを抑えることが出来ている。よって、往路で記録したドットの占める面積の割合と、復路で記録したドットの占める面積の割合を各画像領域でほぼ等しく、さらに良好な画像が得られるようになっている。

【0207】このような考えに基づけば、今1×2の大きさにしている画素配列を、さらに拡大することで、従来例(図7)のような構成の記録ヘッドでも色むらと濃淡むらを同時に解決されることが予想できる。実際、このようにすれば、確かに各画像領域内の全体的な色調は均等になり得る。しかし、その一方で、画素配列の単位が大きすぎると、今度はそれ自体が視覚的に感知されるようになり、画像上にザラツキ感が現れ、滑らかさの欠けたものとなってしまう。また、同時に同画素へ、最高400%以上のインクを打ち込むことになるので、記録密度の高い領域などでは、異色同士の境界部で滲みが生じ、好ましくないものとなり易い。

【0208】本実施例は、両方向記録を行う際に起こり得る濃淡むらと色むらという2つの弊害を、前者については各インク色の吐出口配列構成で、後者については分割記録および画素構成によって対処し、解決させていく。そして、特にこれまでの説明では先に淡インクを記録した後に濃インクを記録させるヘッド構成をとっている。しかし、濃淡インクの打ち込み順自体は、これに限ったものでない。すなわち、淡インクノズルと濃インクノズルの位置を逆転させる様な構成を取っても本発明の効果を有効に得ることができる。

【0209】ここで、これまで説明してきた図32で示す記録ヘッド構成と、この構成と濃淡を逆転させた構成の場合との画像比較を簡単に説明する。

【0210】淡インクを先に記録した場合には、その後に着弾される濃インクは既に記録されている淡インクの下側に回り込み、各画素では濃度の低い大きなドットが得られる。これに対し、濃インクを先に記録した場合には、1番最初の記録走査方向で決まる優先色のドットが高い濃度で着弾され、優先色をかなり強く決定づける。この場合、色むらについては淡インクを先に完成させる構成の方が、濃インクを先に記録する構成より現れにくい。これは、淡インクでのインク打ち込み順による発色性の差の方が濃インクでのそれよりも少ないからとも言える。さらに、各ドットが大きく一様に広がるので、全体的には滑らかな画像を得ることができる。従って、本実施例の中でも、淡インクを先に記録する配列を有した記録ヘッドの方がカラーイメージ画像にに対し、より適した構成といえる。

【0211】一方、濃インクを先に記録した場合は、確

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かに色むらは目立ち易いが、濃インクがその後に記録される淡インクによってぼかされることがないので、各画素自体の濃度および解像度が高く、くっきりとした高解像の画像が得られる。よって、濃インクを先に記録するヘッドの方が濃度の高い黒文字画像等により適した構成といえる。

【0212】さらに本実施例では、各色は濃インクと淡インクの2種類の濃度インクで説明してきたが、さらに画像を良好にするために濃度のレベルを3種類以上にしてもよい。この場合、濃度の異なるインクの吐出口列を紙送り方向に図35に示すように配列されれば良い。

【0213】以上説明してきたように、本実施例によれば濃淡インクを吐出する記録ヘッドを持ったカラーインクジェット記録装置において、各色インクをヘッド記録走査方向に、濃淡インク吐出口を紙送り方向に配列させることによって、両方向記録の際のインク打ち込み順に起因する色むらおよび濃淡むらを無くし、良好な画像を得ることができる。

【0214】実施例2の変形例1

次に、上記実施例2の変形例についてを説明する。上記実施例2が濃淡むらをヘッド構成、すなわち吐出口配列構成で、色むらを分割記録法で解決していたのに対し、本実施例では濃淡むらを分割記録法で、色むらをヘッド構成で解消するものである。

【0215】本変形例の記録ヘッド構成を図36に示す。本変形例も上記実施例2と同様、16個の吐出口を1列に配列する記録ヘッドを用いるが、ここでは濃インクヘッドと淡インクヘッドを独立させ、記録走査方向に並列させている。それぞれの吐出口列は、紙送り方向に向かって各色を4吐出口づつ配列させている。

【0216】本例では記録の色順をブラック、シアン、マゼンタ、イエローとしているが、実施例2と同様に紙送り方向の配列順は1通りに限るものではない。また、本例では各色、各濃度につき4吐出口しか吐出口を持ち合わせていないので、分割記録を行うために各記録走査毎の紙送り量は2画素幅となる。

【0217】図37は、本例により記録したときの記録状態を示す。ここでも実施例2と同様に、シアンとイエローで一様なグリーン画像を記録する場合を例に取っている。

【0218】記録の初めにおいて、ブラックデータが存在する場合には用紙の先端はブラック吐出口位置に設定されるが、本例で説明するグリーン画像ではブラックインクを記録する必要がないので、記録用紙は、同図に示すようにシアンの吐出口位置まで移動される。この時シアン吐出口は全部で4吐出口存在するが、分割記録を行うために、第1記録走査ではシアン吐出口の下半分の2吐出口の位置に記録用紙が設定される。

【0219】第1記録走査は往路記録であるので、記録画素へは、濃インクのシアン、淡インクのシアンの順番

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に着弾される。濃インクが先に着弾されるのでここに記録される画素では濃度の高くドット輪郭のはっきりしたシアンの周りを、濃度の薄い大きなシンドットが薄く囲む形になる。その後、2画素幅の紙送りが行われ、次の第2記録走査へと続く。なお、本例でも上記実施例2と同様に、各記録走査で同時に記録される画素配列は1×2の画素群が互い違いになったものを用いている。

【0220】第2記録走査は、復路走査であり、淡インクのシアン、濃インクのシアンの順に各画素へインクが着弾される。淡インクが既に着弾された後に記録される濃インクのドットは淡インクのドットの周りに大きく滲み込み、往路走査で得られるドットよりも濃度の低い一様なものとなる。ここまで2回の記録走査でシアンの記録が完成する第1画像領域では濃度の高いシンドットと濃度の低いシンドットが約半数づつ混在することとなる。また、この第1画像領域に続く第2画像領域では、この時の復路記録で、シンドットの半分が記録されている。

【0221】次の第3および第4記録走査では、第1画像領域はマゼンタ吐出口部に対応して位置するので、実際の記録は行われない。しかし、これに続く第2画像領域以下ではシアン吐出口部に位置する各画像領域で順次シンドットの記録がなされていく。

【0222】シンドットの記録がなされた第1画像領域が次に記録されるのは、この領域がイエロー吐出口部に対応して位置する第5記録走査である。イエローインクは既にシアンインクが記録されている上から、濃インク、淡インクの順に着弾される。もし、白紙上にこの順番にインクが打たれれば、記録画素は濃度の高いイエロー一画素となるが、既にシアンインクが吸収されている上に記録されるので、イエローインクはシアンインクの周りや下側に大きく回り込み、ドット形状や濃淡の差異はここでは現れない。

【0223】以上のように順次記録走査を往復で繰り返していくとき、各画像領域ではシアン吐出口部に位置した時と、2走査後のイエロー吐出口部に位置した時の記録が成されている。ここでは、全ての画像領域においてシアンの記録が完了された後にイエローが記録されるので、従来例で説明した往復記録時の色むら弊害は本例の記録ヘッド構成によって解決される。

【0224】以上説明してきたように本変形例によれば、濃淡インクヘッドを持ったカラーインクジェット記録装置において、濃淡インクの吐出口を記録走査方向に、また、各色インク吐出口を紙送り方向に配列させることによって、両方向記録の際のインク打ち込み順に起因する色むらおよび濃淡むらを無くし、良好な画像を得ることができる。

【0225】なお、本例においても、紙送り方向に配列するインク色の順番は1通りに限ったものではない。どの様な配列でも本発明において同様な効果を得ることが

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できる。本例で特にブラックインクを先頭に持ってきたことは、4色の中でブラックインクの濃度および解像度を最も高くしようと意図したものであり、ブラックインクの濃度、および解像度が高いことは、鮮明な黒文字画像を得ることにつながる。

【0226】実施例2の変形例2

次に、実施例2の他の変形例について説明する。

【0227】上述した実施例2およびその変形例1では、複数の記録ヘッドを用い、色または濃度によってそれぞれ1ヘッドづつ対応させたものであった。これに対し、本例に用いる記録ヘッドは1つのみである。すなわち、実施例1等に示したように、全ての濃度および色に対応したインク吐出口をこの記録ヘッド内に予め配列させ、これらを一体に構成する。

【0228】図38は、本実施例に用いる記録ヘッドの構成を示す模式図である。

【0229】各色インクについてそれぞれ濃インクの吐出口を8個、淡インクの吐出口を8個有し、計16個の吐出口で1色の記録を完成させていく。各色の吐出口群は紙送り方向にブラック(K)、シアン(C)、マゼンタ(M)、イエロー(Y)の順に配列されているが、この時隣合う各色の吐出口群は互いに1吐出口分重なりあつていている。

【0230】図38において、ヘッド上に実線で示した横線は、紙送り状態を示したものであり、記録紙の先頭画素が4画素幅の紙送り走査で、順次どの位置送られるかを示したものである。この図に見るように本実施例のような吐出口配列構成を探ると、この先頭画素は各色配列する8吐出口の色毎に異なる部分に位置していくことになる。すなわち、この先頭画素はブラックにおいては分割記録のつなぎ部となり得るが、シアン、マゼンタ、イエローにおいてはつなぎ部とはならない。

【0231】図39に示す実施例による記録状態を、上記各実施例と同様に一様なグリーン画像を記録する状態として示している。本例も、異なる色のインク吐出口が紙送り方向に配列していることは上記変形例1と同様であるので、各記録走査の往復記録では、シアン、あるいはイエローの吐出口位置にきた画像領域のみが記録されることとなる。ここで言う画像領域とは各色記録ヘッドが同時に記録する4画素幅の領域のことを指し、すなわち各色のつなぎ部とつなぎ部の間の領域のことを言う。従って、本例ではこれまでの実施例の画像領域とは異なり、各色でそれぞれ相互なる画像領域を構成していることになる。

【0232】図40は、図39における第6記録走査後の記録画像と各色のつなぎ部(画像領域)を示したものである。ここでは各色がそれぞれ1画素ずつされた位置にそれぞれのつなぎ部(画像領域)が現れていることを示している。このように、色毎につなぎ部を異なった位置に現れるようにすることにより、これまで上記実施例

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2および変形例1で述べてきた本発明の効果以外にも、各記録走査毎に行われる紙送り量のむらをさらに改善することができる。

【0233】ところで、本例では、色毎につなぎ位置を異ならせるために記録ヘッド内の吐出口位置を各色1吐出口ずつ重ねるように構成したが、つなぎ位置を異ならせるための吐出口配列構成はこの配列に限ったものではない。例えば、逆に1画素ずつ離して各色を配列させても同様な効果は得られ、この場合は両方向記録による色むらの要素を完全に省くことができる。

【0234】また、記録ヘッド内の各共通液室間の仕切り部分を確実なものとするためにも、ある程度の距離をおいて吐出口列を配列することは記録ヘッド作成工程においても好ましいことである。

【0235】さらに、記録に関与する吐出口の数が増し、紙送り量も大きくなれば様々な位置に各色のつなぎ部を現れるようにすることもできる。

【0236】さらに、本例においても上記変形例1と同様に、紙送り方向に配列するインク色の順番は1通りに限ったものではない。どのような配列でも同様な効果を得ることができる。

【0237】以上説明した実施例2および変形例1、2においては、全て2分割記録による画像形成を例にとりを説明したが、本発明の効果をさらに有効なものにするための手段として、より分割数の多い分割記録も可能である。記録分割数を多くすることは1つの画像領域に対しさらに多くの吐出口を適用することになり、また、1回の記録走査で同画像領域内に打ち込まれるインクの絶対量も減る。よって、画像をより滑らかにすることができる一方で、これまで説明してきた滲み出しによる色むらや濃淡むらへの効果も期待できる。

【0238】図41は本発明を適用したインクジェット記録装置のインク吸引動作を示すための図であり、図18に示したキャップ部分を模式的に示す断面図である。

【0239】図41において、各キャッピング17の内部には多孔質のインク吸収体20が設けられている。このインク吸収体20は、図41(A)に示されるように、キャッピング時に吐出口形成面21の近傍に位置するように配設されている。なお、図41中の高密度の斜線部分30は吐出口から吸い出された(吸引された)インクを示す。

【0240】図41(A)は、キャップ117を吐出口面21に密着させて吸引ポンプを動作させ、チューブ27を通してキャップ117内に負圧を発生させることにより各吐出口からインクを吸引した後吸引ポンプの動作を停止した時の状態を示す。この状態では、ある量のインクが吸引されることにより吸引ポンプ内の負圧がほとんど解消されている。すなわち、各吐出口のメニスカスが破壊させない程度に負圧が減少している。負圧が強い状態のままキャップ117を吐出口面21から引き離す

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と、キャップ15内に瞬時に大気圧がかかり、この急激な圧力変動により吐出口内のメニスカスが破れ、吐出口内に空気が入り込んで吐出不良を起こす場合がある。

【0241】また、図43に示すように、吐出口形成面とインクとの界面ではインクの付着力や吐出口内の負圧によりインクを吸い上げようとする力が作用し、さらにキャップ103内インクにはインク自身が凝集しようとする表面張力が作用するため、インク104の間にくびれ105が生じ、キャップが離れるに従い、インク104の各くびれ105部分の断面積が小さくなつてそこが一番弱くなつてしまい、ついには各くびれ105の部分でインク間のつながりが切れ、吐出口形成面上にインク滴が残ることがある。

【0242】図41(A)の状態では、キャップ117内はほとんどインクで充満しており、インク吸収体20も飽和して吸収能力がほとんど無い状態にある。もし、このままの状態でキャップを引き離すと、上述した図43の場合と同様に吐出口形成面21に多量のインクが残つてしまつ結果となる。そこで本実施例においては、キャリッジを図中の右方向へ微少移動させることにより、キャップ117と吐出口との間に隙間31を生じさせる。この時のキャリッジの微少移動量は、キャップ117による密閉が可能な範囲以上の適当量に設定される。

【0243】図42はキャリッジの上記微少移動の状態を示す模式図であり、図42(A)は移動前の状態を、図42(B)は移動後の状態を示す。また、図41

(B)は、図41(A)の状態からキャリッジを上記微少移動させた直後のキャップ内部の状態を示す。図41(B)および図42(B)に示すように、隙間31を生じさせたところで、再び吸引ポンプを動作させる。この時のキャップ内部の状態を図41(C)に示す。すなわち、図41(B)の状態にして吸引ポンプを再び作動させると、キャップがリーク(開放)状態になつてゐるため、図41(C)に示すように、チューブ27を通してキャップ15内のインクのみが吸引され、キャップ117内に設けられた多孔質のインク吸収体20は再びインク吸収可能な状態に回復する。また、図41(C)の状態では、多孔質のインク吸収体20は吐出口面21に近接しているので、吐出口形成面21上のほとんど全てのインクがインク吸収体20に吸収される。こうしてインク吸収体20に吸収されたインクもチューブ27を通して吸引される。

【0244】そして、この時、キャリッジをもう一度元の位置、すなわち図41(A)および図42(A)の位置に戻して、インク吸収性能を十分に回復したインク吸収体20が吐出口形成面21の全領域に対して近接する状態にする。こうすることにより、吐出口形成面21上のインク残りをさらに減少させることができる。

【0245】吐出口形成面上のインク残りが減少するため回復動作により混色発生を防止できる。

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【0246】隙間31を生じさせるため、上記実施例ではキャリッジを主走査方向に移動させたが、副走査方向に移動させても良い。さらに、キャリッジではなく、キャップ側を上下、左右、前後、斜めなどに移動させる構成しても良い。

【0247】以上により、大気開放弁を設けることなく吐出口形成面上のインク残りをなくすことができる。

【0248】図44は吸引動作の他の例を示すためのキャップ部分の模式的断面図である。

【0249】図44において、各キャップ117の内部には多孔質のインク吸収体52が設けられている。このインク吸収体52の容量は、吸引ポンプの吸引量(一動作によるインクの強制排出量)よりも大きい値、またはインクジェットユニットのインク流路の内容積よりも大きい値に設定されている。そして、前述インク吸収体52は、図44(A)に示すように、キャッピング時に吐出口形成面81の近傍に位置するように配設されている。なお、図44中の斜線部分53は吐出口から吸い出された(吸引された)インクを示す。

【0250】図44(A)は、キャップ117を吐出口形成面81に密着させて吸引ポンプを動作させ、チューブ19を通してキャップ117内に負圧を発生させることにより各吐出口からインク52が吸引される状態を示す。その後、所定のタイミングで、図44(B)に示すように、記録ヘッドとキャップ117とを分離し、その間に隙間54を形成する。この記録ヘッドとキャップ117を分離するタイミングとしては、吸引ポンプの動作を停止させて所定量のインクが吸引されることにより吸引ポンプ内の負圧がほとんど解消された時点、もしくは、キャップ117内に負圧が作用している状態であつても所定量のインクを吸引した時点などが選定される。なお、吸引ポンプにより記録ヘッドから吸引されるインクは、チューブあるいはインク流路等を通して不図示の廃インクタンクへ送出される。この廃インクタンクは廃インクを吸収保持する多孔質のインク吸収体で構成しても良い。

【0251】図44において、多孔質のインク吸収体52の容量は、前述のごとく、吸引ポンプの吸引量(一動作によるインクの強制排出量)よりも大きい値、または記録ヘッドのインク流路の内容積よりも大きい値に設定されている。そのため、吐出口形成面81とキャップ117の間にあるインク53は、図44(C)に示すように、インク吸収体52の吸引力により該インク吸収体52側へ持つて行かれる。その結果、図44(D)に示すように、記録ヘッドの吐出口形成面81にインクを残さない状態で吸引回復動作を終了することができる。こうして吐出口形成面81にインクが残らない状態で吸引回復動作が終了するので、異色インクの混色を防止できる。

【0252】また、キャップ内に多孔質のインク吸収体

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52を充填することにより、吸引時のキャップ117内のインク流れに方向性(吐出口面81から吸引ポンプ側へ向かう方向)を持たせることができ、吐出口形成面81に付着した異色インクが吐出口内に侵入するという混色を防止することができる。

【0253】(その他)なお、本発明は、特にインクジェット記録方式の中でも、インク吐出を行わせるために利用されるエネルギーとして熱エネルギーを発生する手段(例えば電気熱変換体やレーザ光等)を備え、前記熱エネルギーによりインクの状態変化を生起させる方式の記録ヘッド、記録装置において優れた効果をもたらすものである。かかる方式によれば記録の高密度化、高精細化が達成できるからである。

【0254】その代表的な構成や原理については、例えば、米国特許第4723129号明細書、同第4740796号明細書に開示されている基本的な原理を用いて行うものが好ましい。この方式は所謂オンデマンド型、コンティニュアス型のいずれにも適用可能であるが、特に、オンデマンド型の場合には、液体(インク)が保持されているシートや液路に対応して配置されている電気熱変換体に、記録情報に対応していく核沸騰を越える急速な温度上昇を与える少なくとも1つの駆動信号を印加することによって、電気熱変換体に熱エネルギーを発生せしめ、記録ヘッドの熱作用面に膜沸騰を生じさせて、結果的にこの駆動信号に一対一で対応した液体(インク)内の気泡を形成できるので有効である。この気泡の成長、収縮により吐出用開口を介して液体(インク)を吐出させて、少なくとも1つの滴を形成する。この駆動信号をパルス形状とすると、即時適切に気泡の成長収縮が行われるので、特に応答性に優れた液体(インク)の吐出が達成でき、より好ましい。このパルス形状の駆動信号としては、米国特許第4463359号明細書、同第4345262号明細書に記載されているようなものが適している。なお、上記熱作用面の温度上昇率に関する発明の米国特許第4313124号明細書に記載されている条件を採用すると、さらに優れた記録を行うことができる。

【0255】記録ヘッドの構成としては、上述の各明細書に開示されているような吐出口、液路、電気熱変換体の組合せ構成(直線状液流路または直角液流路)の他に熱作用部が屈曲する領域に配置されている構成を開示する米国特許第4558333号明細書、米国特許第4459600号明細書を用いた構成も本発明に含まれるものである。加えて、複数の電気熱変換体に対して、共通するスリットを電気熱変換体の吐出部とする構成を開示する特開昭59-123670号公報や熱エネルギーの圧力波を吸収する開孔を吐出部に対応させる構成を開示する特開昭59-138461号公報に基いた構成としても本発明の効果は有効である。すなわち、記録ヘッドの形態がどのようなものであっても、本発明によれば記録

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を確実に効率よく行うことができるようになるからである。

【0256】加えて、上例のようなシリアルタイプのものでも、装置本体に固定された記録ヘッド、あるいは装置本体に装着されることで装置本体との電気的な接続や装置本体からのインクの供給が可能になる交換自在のチップタイプの記録ヘッド、あるいは記録ヘッド自体に一体的にインクタンクが設けられたカートリッジタイプの記録ヘッドを用いた場合にも本発明は有効である。

【0257】また、本発明の記録装置の構成として、記録ヘッドの吐出回復手段、予備的な補助手段等を付加することは本発明の効果を一層安定できるので、好ましいものである。これらを具体的に挙げれば、記録ヘッドに對してのキャッピング手段、クリーニング手段、加圧或は吸引手段、電気熱変換体或はこれとは別の加熱素子或はこれらの組み合わせを用いて加熱を行う予備加熱手段、記録とは別の吐出を行なう予備吐出手段を挙げることができる。

【0258】また、搭載される記録ヘッドの種類ないし個数についても、例えば単色のインクに対応して1個のみが設けられたもの他、記録色や濃度を異にする複数のインクに対応して複数個数設けられるものであってもよい。すなわち、例えば記録装置の記録モードとしては黒色等の主流色のみの記録モードだけではなく、記録ヘッドを一体的に構成するか複数個の組み合わせによるかいずれでもよいが、異なる色の複色カラー、または混色によるフルカラーの各記録モードの少なくとも一つを備えた装置にも本発明は極めて有効である。

【0259】さらに加えて、以上説明した本発明実施例においては、インクを液体として説明しているが、室温やそれ以下で固化するインクであって、室温で軟化もしくは液化するものを用いてもよく、あるいはインクジェット方式ではインク自体を30℃以上70℃以下の範囲内で温度調整を行ってインクの粘性を安定吐出範囲にあるように温度制御するものが一般的であるから、使用記録信号付与時にインクが液状をなすものを用いてもよい。加えて、熱エネルギーによる昇温を、インクの固形状態から液体状態への状態変化のエネルギーとして使用せしめることで積極的に防止するため、またはインクの蒸発を防止するため、放置状態で固化し加熱によって液化するインクを用いてもよい。いずれにしても熱エネルギーの記録信号に応じた付与によってインクが液化し、液状インクが吐出されるものや、記録媒体に到達する時点ではすでに固化し始めるもの等のような、熱エネルギーの付与によって初めて液化する性質のインクを使用する場合も本発明は適用可能である。このような場合のインクは、特開昭54-56847号公報あるいは特開昭60-71260号公報に記載されるような、多孔質シート凹部または貫通孔に液状又は固形物として保持された状態で、電気熱変換体に対して対向するような形態としても

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よい。本発明においては、上述した各インクに対して最も有効なものは、上述した膜沸騰方式を実行するものである。

【0260】さらに加えて、本発明インクジェット記録装置の形態としては、コンピュータ等の情報処理機器の画像出力端末として用いられるものの他、リーダ等と組合せた複写装置、さらには送受信機能を有するファクシミリ装置の形態を探るもの等であってもよい。

【0261】

【発明の効果】以上の説明から明らかのように、本発明によれば濃度や色等、種類がそれぞれ異なるインクを吐出する複数の吐出口列を、その記録ヘッドの移動方向とは異なる方向に一体に分割して設けることができる。記録ヘッドそのものや、これを移動させるための機構の小型化が可能となる。

【0262】また、1回の移動で記録可能な領域を分割し、かつこの分割領域の画素を複数回の移動によって分割して記録する場合には、記録ヘッドにおける上記複数の吐出口列の配置によって、記録ヘッドの上記複数の種類の異なるインクの重なる順序を常に等しくすることができる。

【0263】この結果、装置の小型化等が可能となるとともに、カラー記録の際の色むらや濃淡むらの低減されが画像を記録することができる。

【図面の簡単な説明】

【図1】従来の濃淡インクを用いたカラーインクジェット記録装置の要部構成を示す斜視図である。

【図2】濃度むらの発生を説明するための説明図である。

【図3】濃度むらの発生を説明するための説明図である。

【図4】濃度むらの緩和を説明するための説明図である。

【図5】分割記録法を説明するための吐出口配置およびそれによる記録ドット配置を示す模式図である。

【図6】記録画像における色むら発生の原因を説明するための説明図である。

【図7】従来例の記録ヘッドの模式的正面図である。

【図8】本発明の実施例1におけるカラーインクジェット記録装置の制御構成を示すブロック図である。

【図9】図8に示す画像信号処理回路の一例を示すブロック図である。

【図10】図8に示す濃淡振り分けテーブルの模式図である。

【図11】本発明の一実施例におけるカラーインクジェット記録装置の要部構成を示す斜視図である。

【図12】本発明の一実施例におけるインクジェットユニットの構成を示す分解斜視図である。

【図13】上記インクジェットユニットを構成する溝付天板を示す斜視図である。

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【図14】本発明の実施例にかかるインクジェットユニットのインク吐出口配列を示す模式図である。

【図15】図14(A)に示す吐出口配列のインクジェットユニットを用いた場合の画像形成過程を示す説明図である。

【図16】図14(B)に示すインク吐出口配列のインクジェットユニットを用いた場合の画像形成過程を示す説明図である。

【図17】図14(C)に示すインク吐出口配列のインクジェットユニットを用いた場合の画像形成過程を示す説明図である。

【図18】本発明の他の実施例におけるカラーインクジェット記録装置の要部構成を示す斜視図である。

【図19】上記他の実施例におけるインクジェットユニットの構成を示す分解斜視図である。

【図20】上記他の実施例にかかるインクジェットユニットの溝付天板を示す斜視図である。

【図21】上記他の実施例に關し、同一インクジェットユニット内に濃インク用、淡インク用の吐出口列を有するインクジェットユニットを示す模式図である。

【図22】上記他の実施例に關し、同一インクジェットユニット内に濃インク用、中濃度インク用、淡インク用の吐出口列を有するインクジェットユニットを示す模式図である。

【図23】上記他の実施例に關し、同一インクジェットユニット内に濃インク用、淡インク用の吐出口列を有するインクジェットユニットを示す模式図である。

【図24】上記他の実施例に關し、同一インクジェットユニット内に濃インク用、淡インク用の吐出口列およびインク吐出量が異なる吐出口列を有するインクジェットユニットを示す模式図である。

【図25】図21に示すインク吐出口配列のインクジェットユニットを用いた場合の画像形成過程を示す説明図である。

【図26】図23に示すインク吐出口配列のインクジェットユニットを用いた場合の画像形成過程を示す説明図である。

【図27】図24に示すインク吐出口配列のインクジェットユニットを用いた場合の画像形成過程を示す説明図である。

【図28】本発明のさらに他の実施例に關し、記録に使用する全インク色に対応するインク吐出口列を同一インクジェットユニット内に有するインクジェットユニットを示す図である。

【図29】本発明の実施例に關し、複数のインクジェットユニットを一体的に組み上げた一体インクジェットカートリッジの構造を示す分解斜視図である。

【図30】本発明の実施例に關し、一体型インクジェットカートリッジをキャリッジに搭載したときの様子を示す図である。

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【図31】本発明のさらに他の実施例による記録状態を説明するための説明図である。

【図32】本発明の実施例2にかかる記録ヘッド構成を示す模式的正面図である。

【図33】分割記録を行った際のインクドットの滲み出し状態を説明するための模式図である。

【図34】上記実施例2による記録状態を説明するための説明図である。

【図35】上記実施例2の変形例にかかる記録ヘッドの模式的正面図である。

【図36】上記実施例2の変形例にかかる記録ヘッドを示す模式的正面図である。

【図37】図35に示した変形例による記録状態を説明するための説明図である。

【図38】上記実施例2のさらに他の変形例にかかる記録ヘッドを示す模式的正面図である。

【図39】図37に示した記録ヘッドによる記録状態を説明するための説明図である。

【図40】図38に示す記録における各色つなぎ位置を説明するための説明図である。

【図41】本発明の実施例におけるキャップ離脱動作を説明する説明図である。

【図42】本発明の実施例におけるキャップ離脱動作を説明する説明図である。

【図43】従来例にかかるキャップ離脱動作を説明する説明図である。

【図44】上記キャップ離脱動作の他の例を説明する説明図である。

【符号の説明】

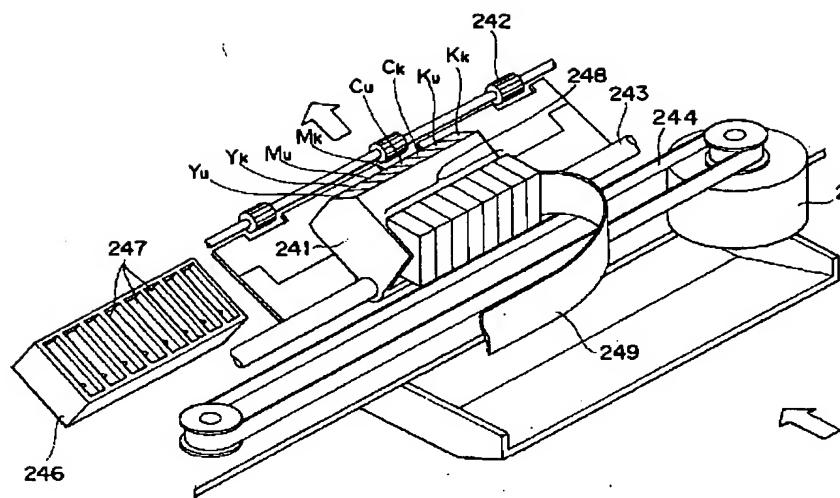
- 1 画像入力部
- 2 操作部
- 3 C P U
- 4 R O M
- 4 a 入出力ガンマ補正テーブル
- 4 b マスキングテーブル
- 4 c 黒生成およびU C Rテーブル
- 4 d 濃淡振り分けテーブル
- 4 e プログラム群

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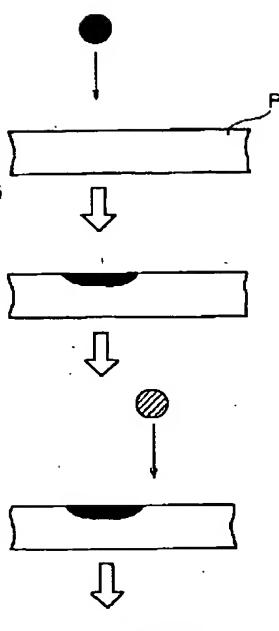
- 5 R A M
- 6 画像信号処理部
- 7 プリンタ部
- 8 バスライン
- 10 1 1 入力ガンマ補正回路
- 1 2 色補正(マスキング)回路
- 1 3 黒生成およびU C R回路
- 1 4 出力ガンマ補正回路
- 1 5 濃淡振り分け回路
- 1 6 2 値化処理回路
- 4 0, 1 1 0, 2 4 0 インクジェットユニット
- 4 1, 2 4 1 キャリッジ
- 4 2, 2 4 2 排紙ローラ
- 4 3, 2 4 3 ガイドシャフト
- 4 4, 2 4 4 駆動ベルト
- 4 5, 2 4 5 キャリッジモータ
- 4 6, 2 4 6 回復ユニット
- 4 7, 1 1 7, 2 4 7 キャップ部
- 5 0 配線基板
- 20 5 1 ヒーターボード
- 5 2 支持体
- 5 3 押えね
- 5 4 溝付天板
- 5 5 インク供給管
- 5 6 フィルタ
- 5 7 インク供給部材
- 5 8, 5 9 勘合用穴
- 6 0 仕切り壁
- 6 1 インク供給口
- 30 6 2 溝
- 2 2 0 フレーム
- 2 2 1 カバー
- 2 2 2 コネクター
- 2 2 3 電極
- 2 2 4 インクジェットユニット
- 2 3 0 インクカートリッジ
- 2 3 1 接点

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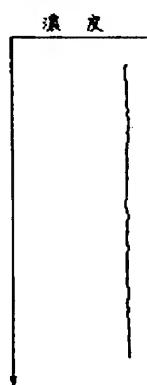
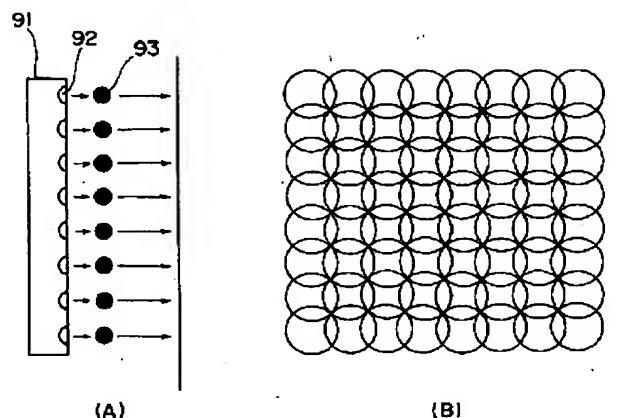
【図1】



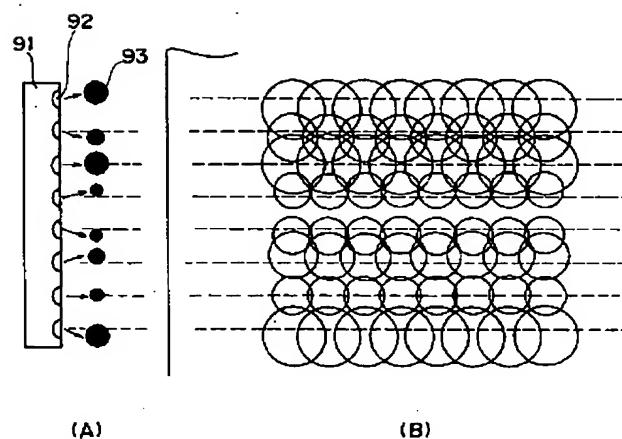
【図6】



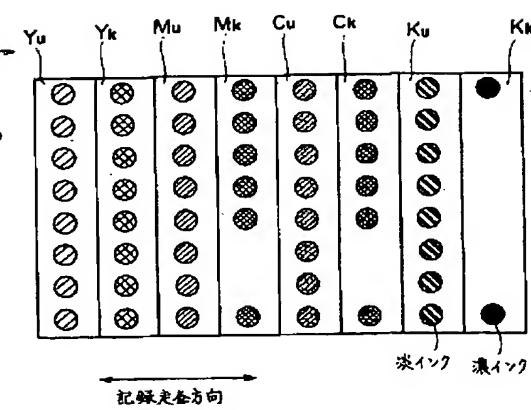
【図2】



【図3】



【図7】



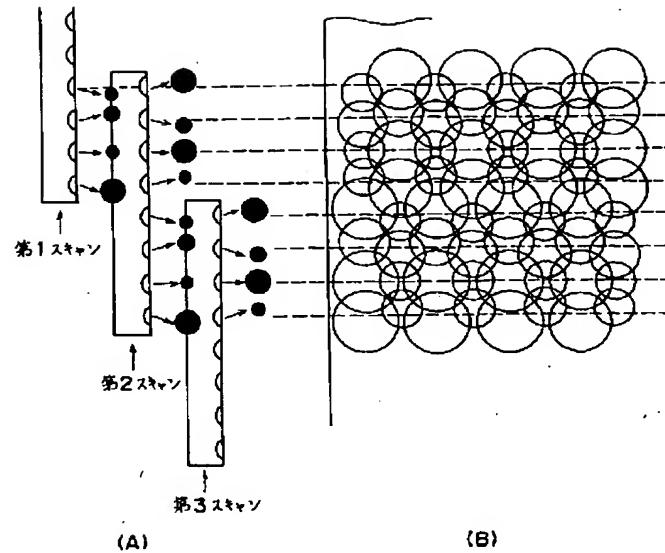
(A)

(B)

(C)

(24)

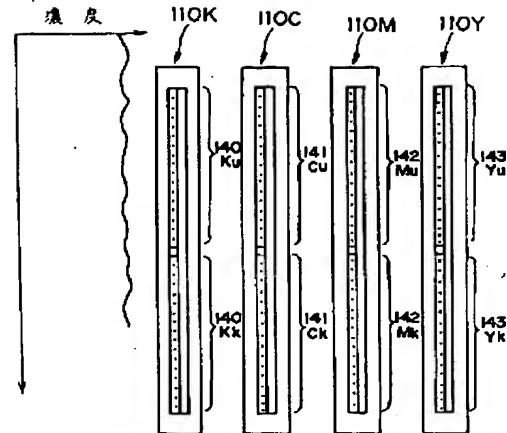
【図4】



(A)

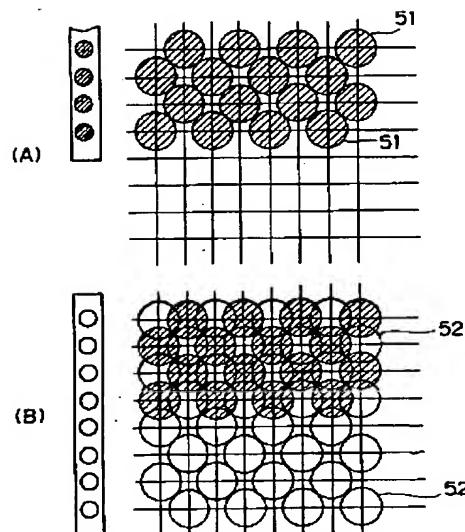
(B)

【図21】

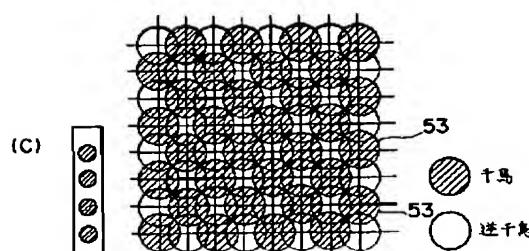
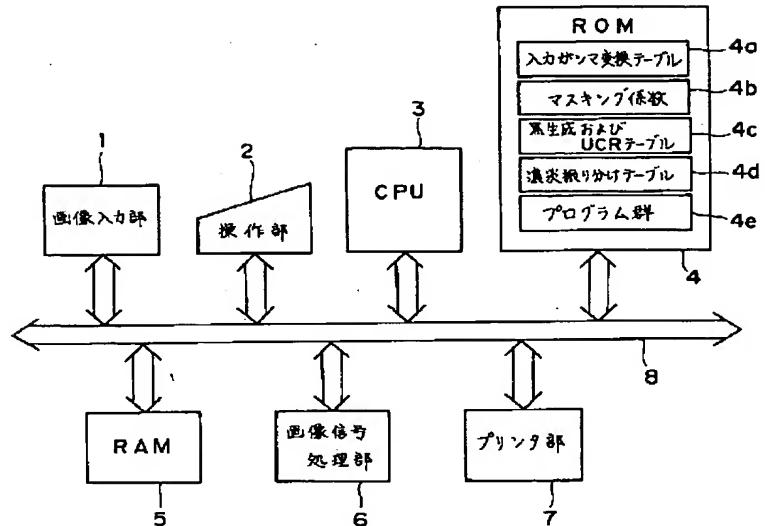


(C)

【図5】

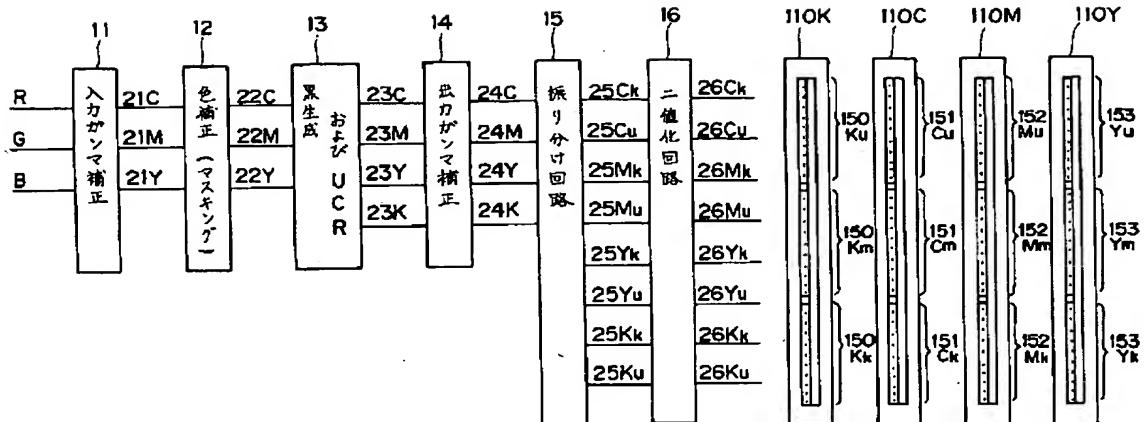


【図8】



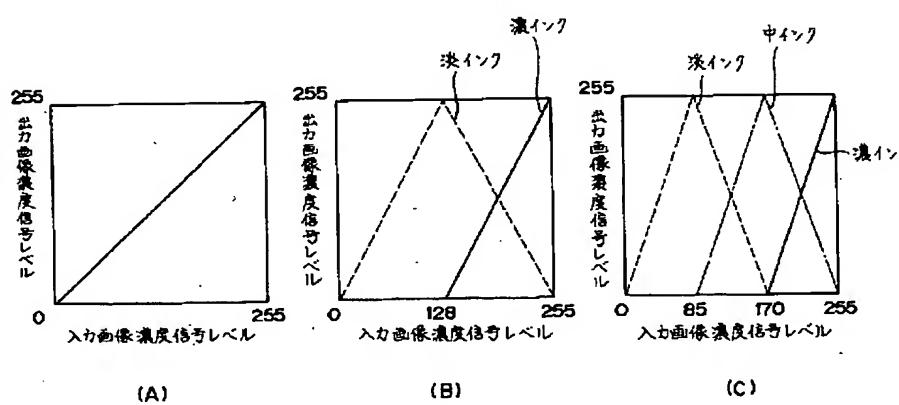
(25)

【図9】

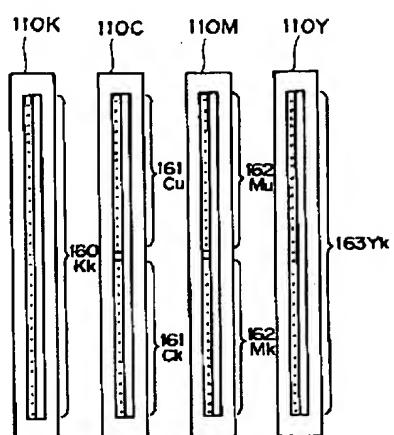


【図22】

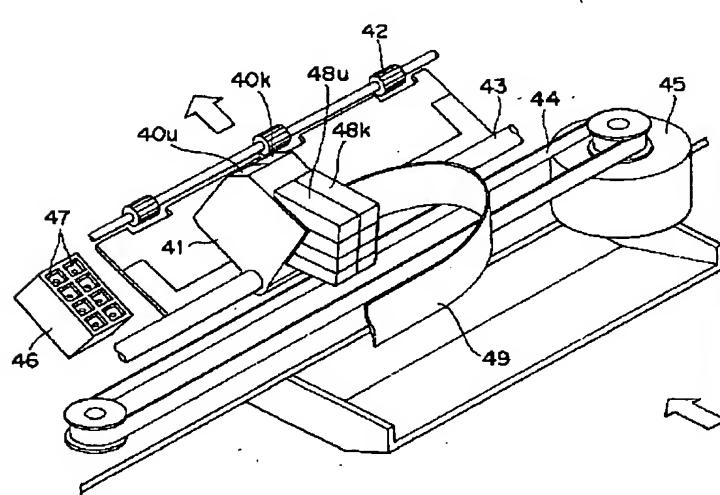
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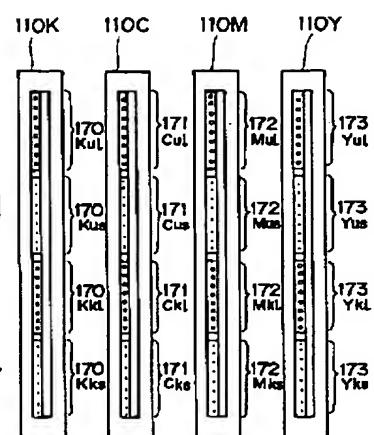
【図23】



【図11】

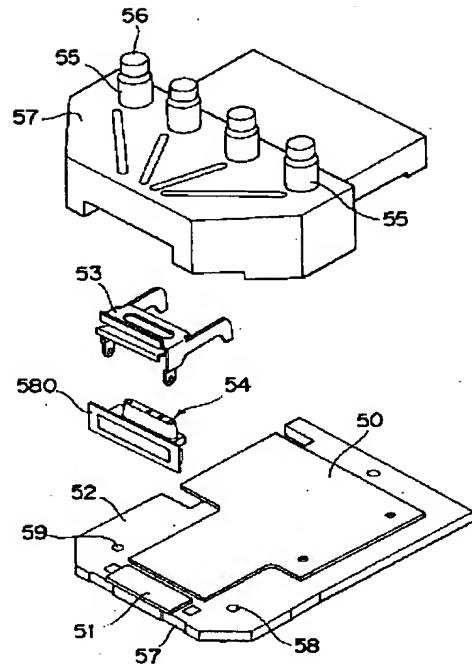


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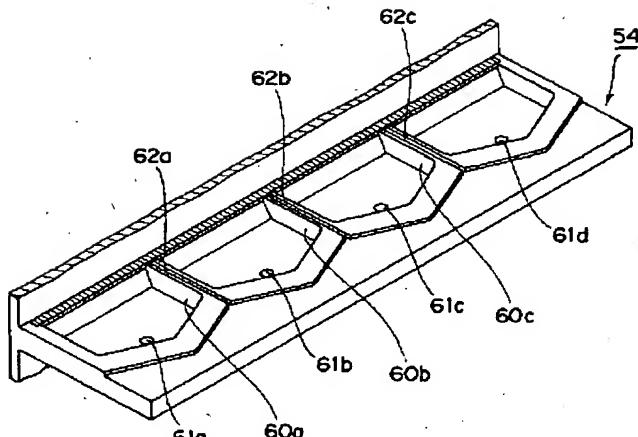


(26)

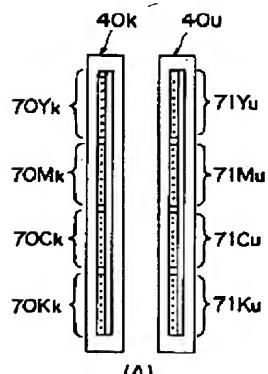
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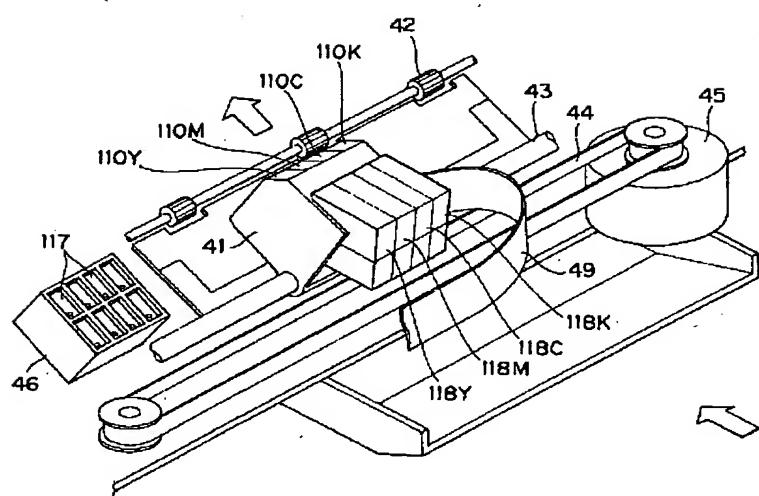
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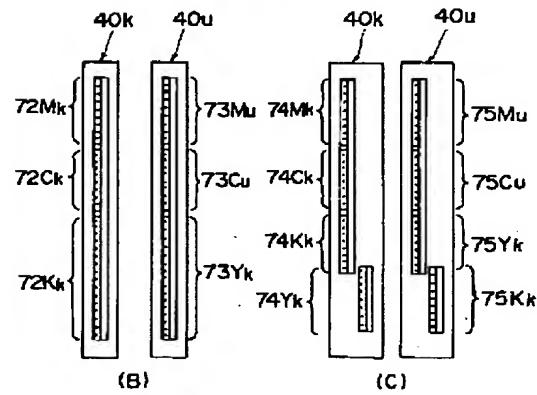
【図14】



(A)

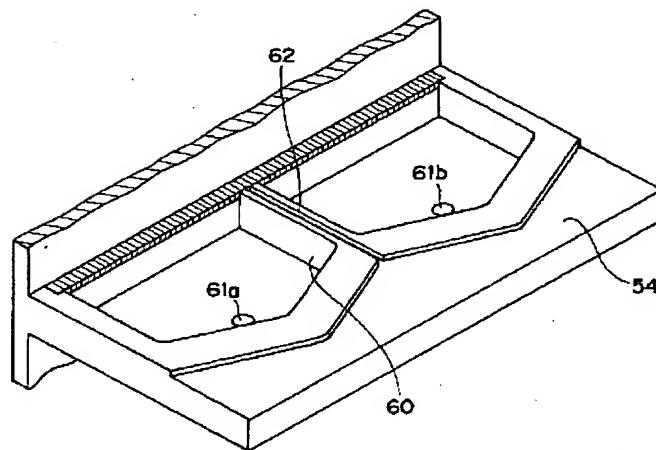


【図20】



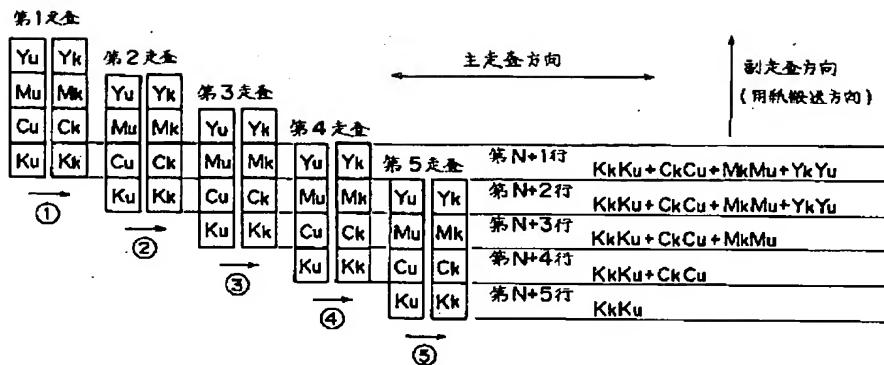
(8)

(C)

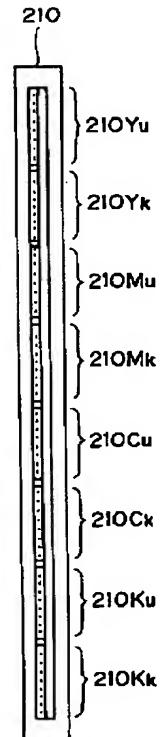


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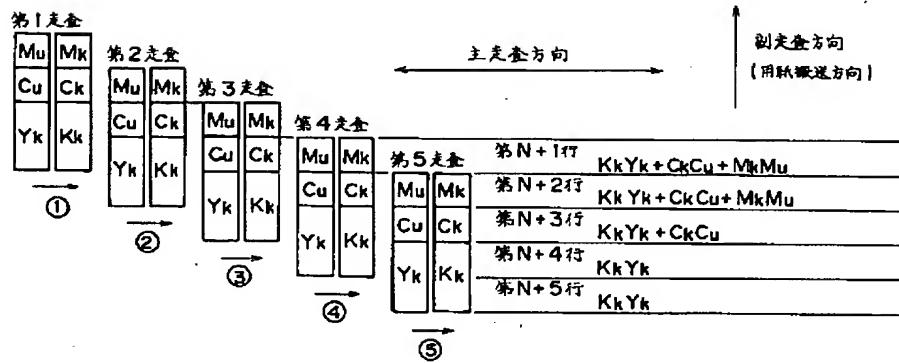
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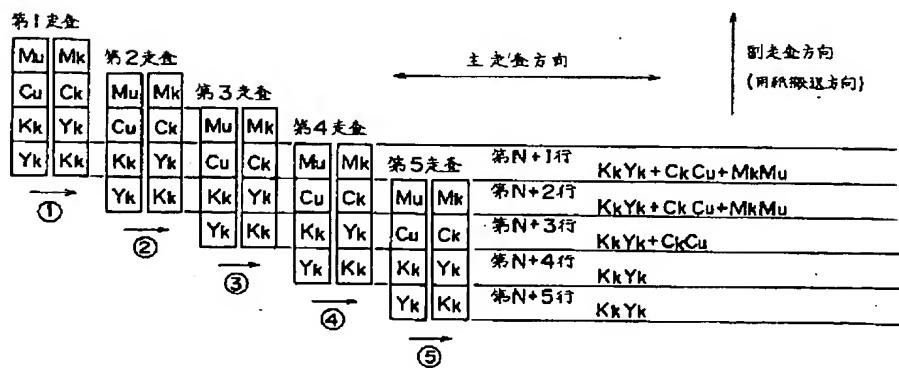
【図28】



【図16】

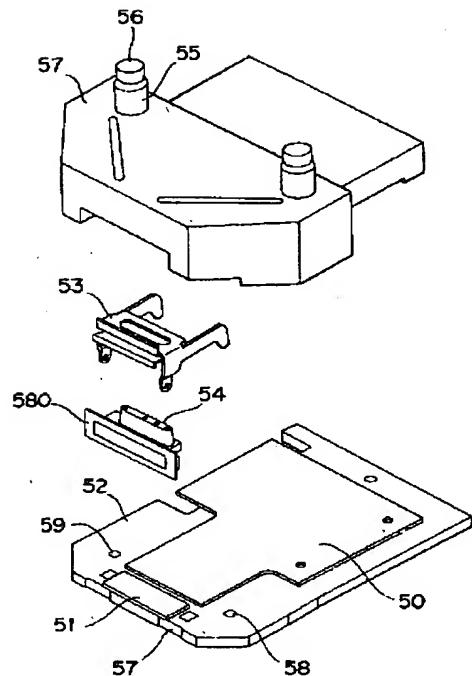


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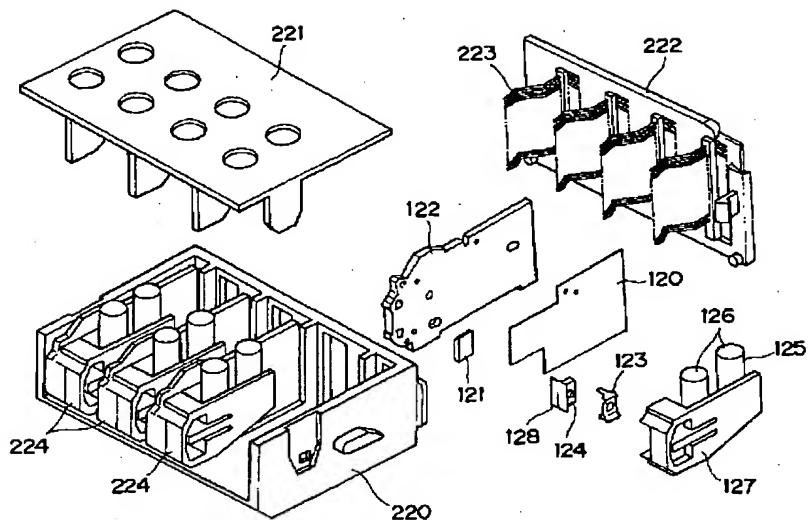


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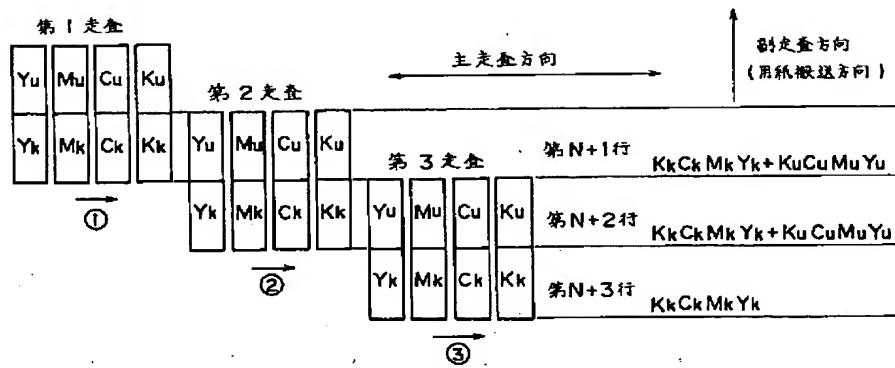
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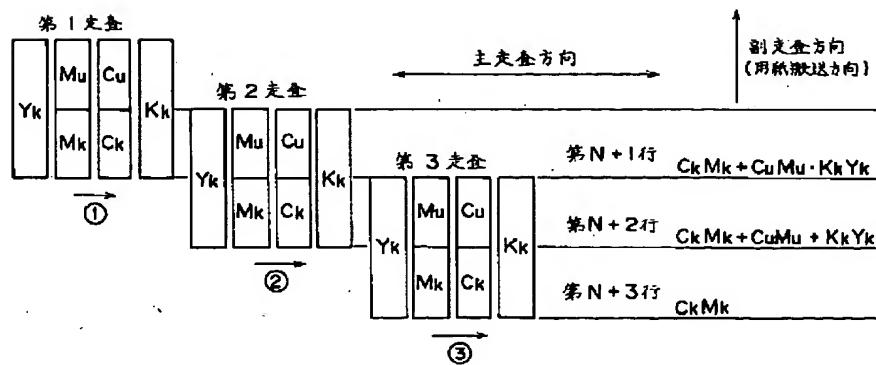
【図29】



【図25】

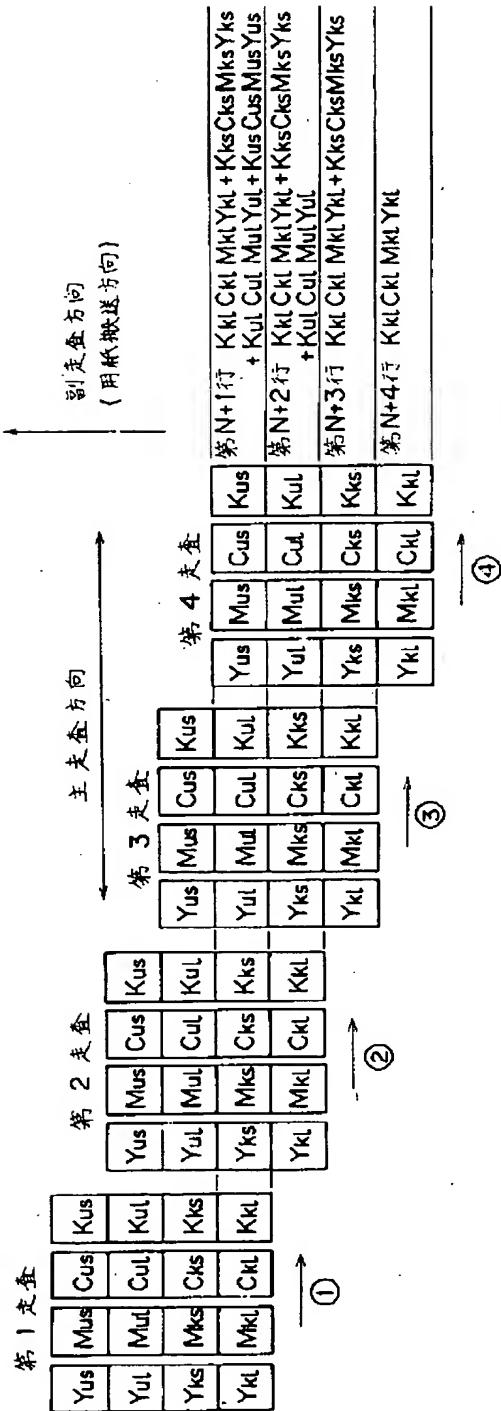


【図26】



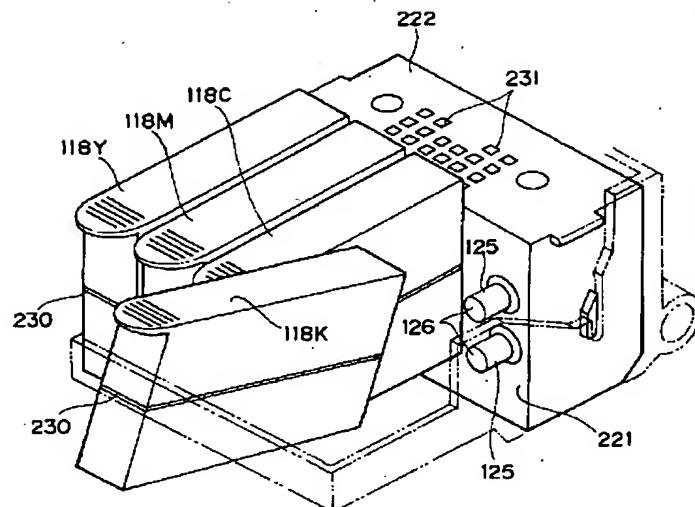
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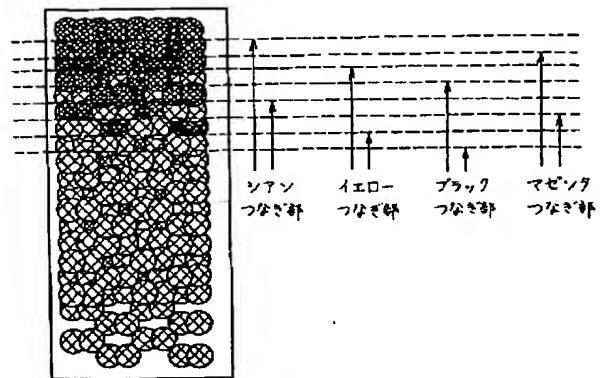


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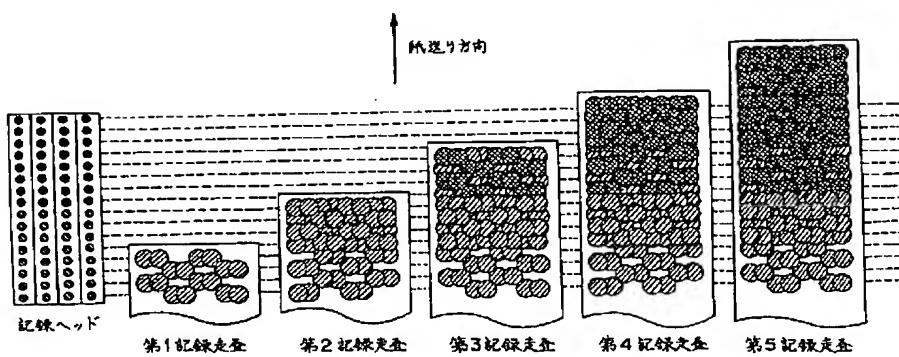
【図30】



【図40】

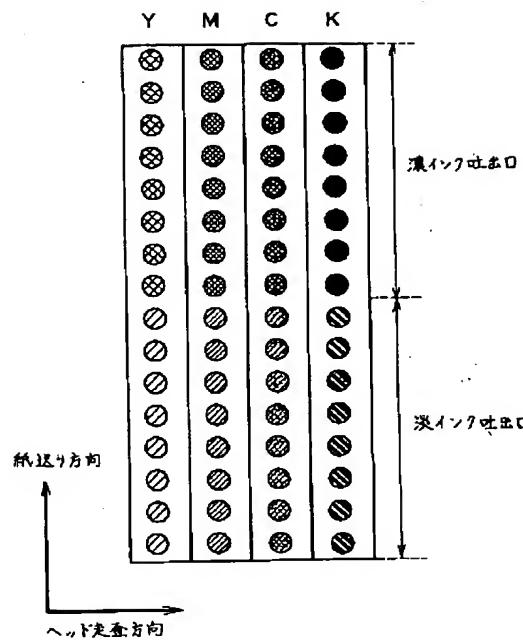


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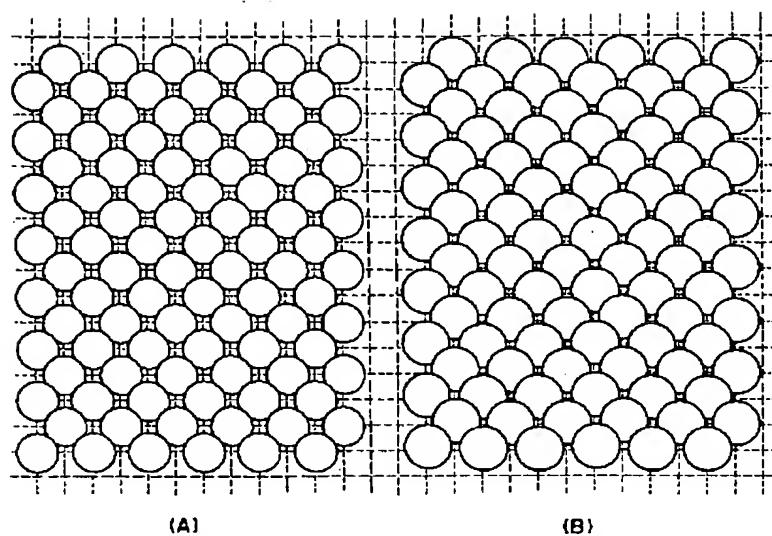


(31)

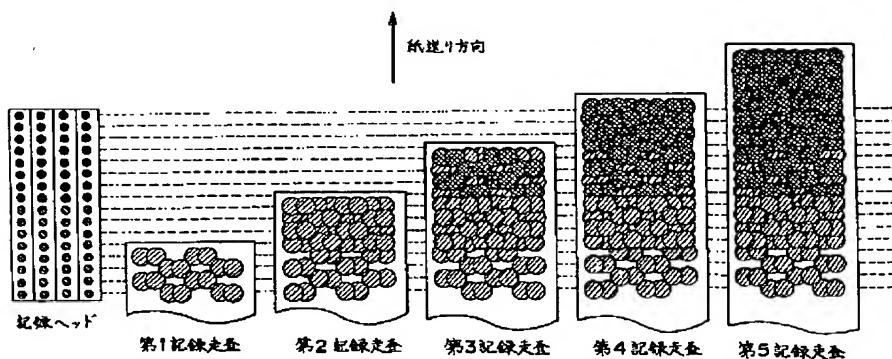
【図32】



【図33】



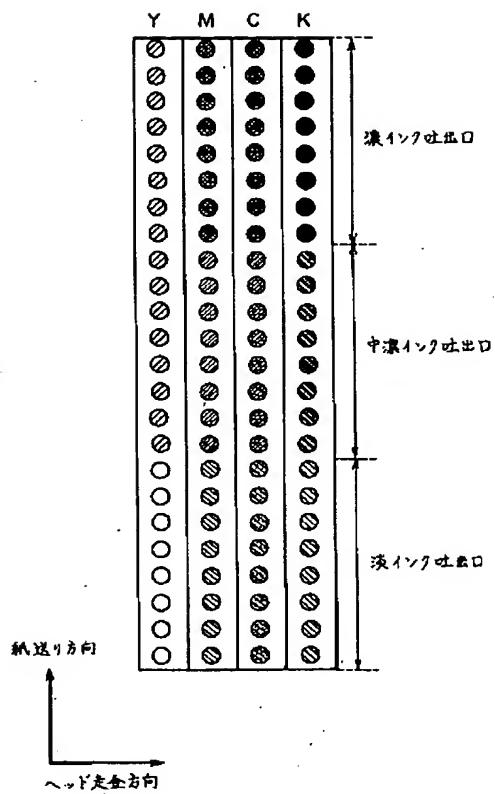
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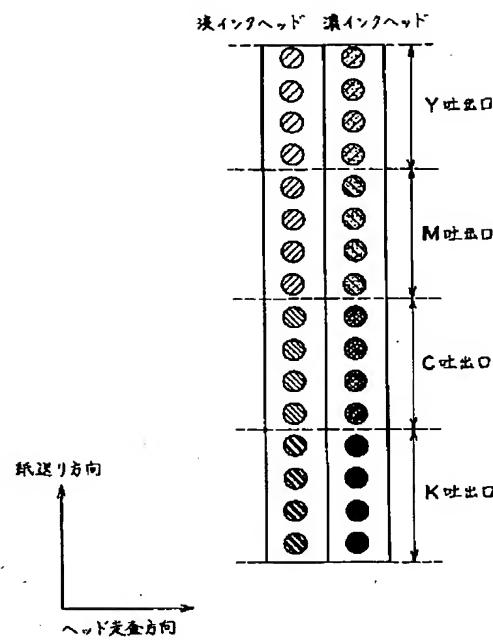
- 液インク $C \rightarrow Y$
- 液インク $Y \rightarrow C$
- 液インク $C \rightarrow Y + 液インク C \rightarrow Y$
- 液インク $Y \rightarrow C + 液インク Y \rightarrow C$

(32)

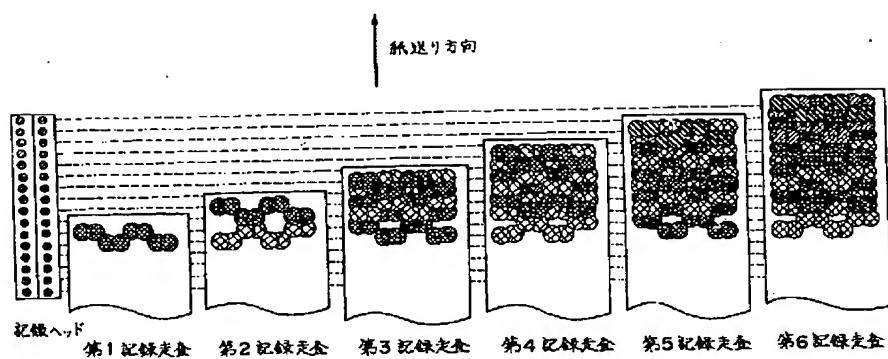
【図35】



【図36】



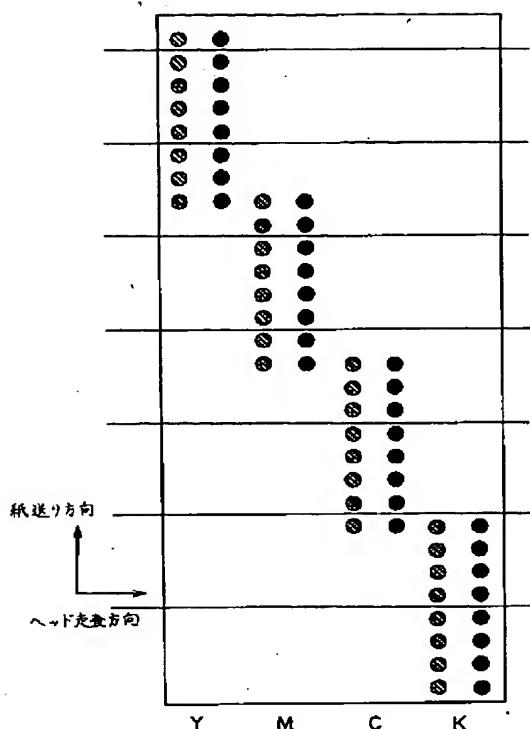
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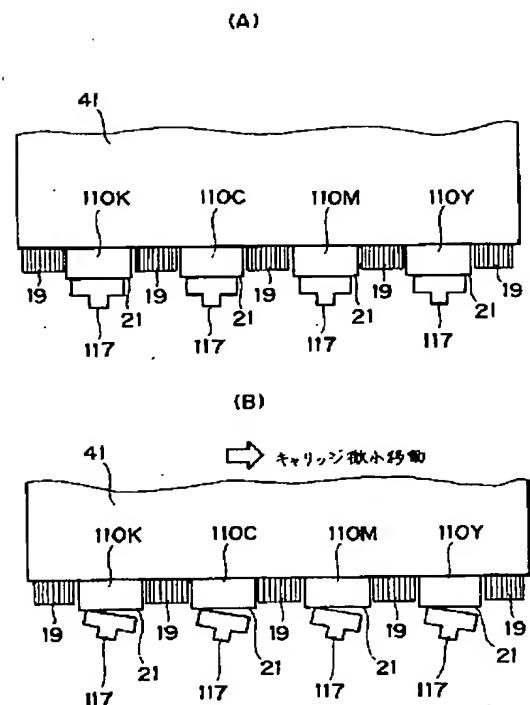
- Cインク 濃→淡
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(33)

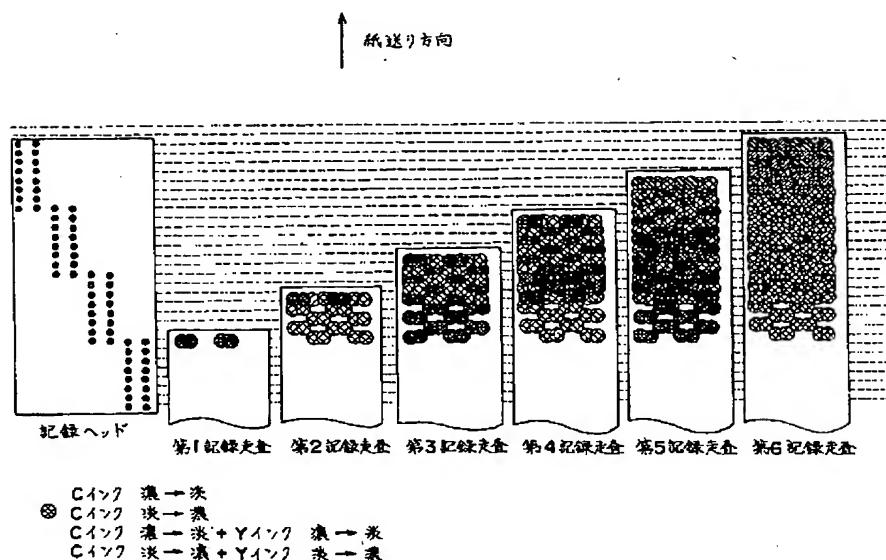
【図38】



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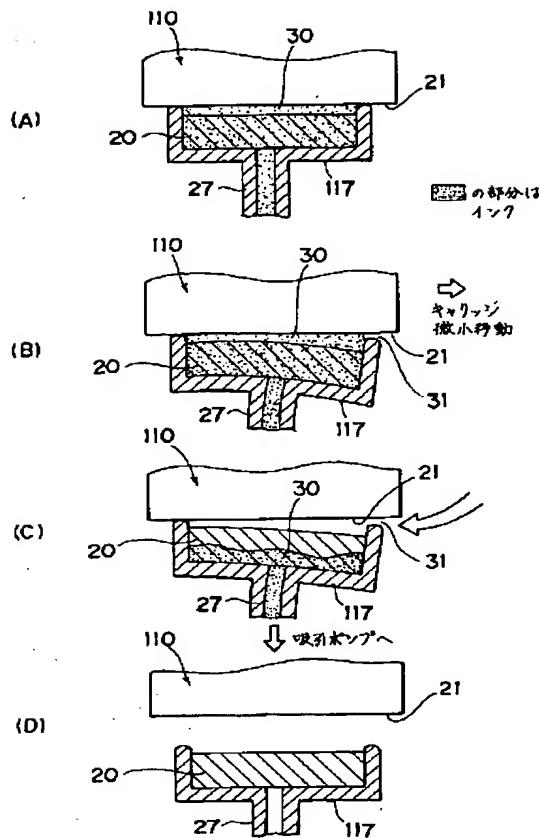


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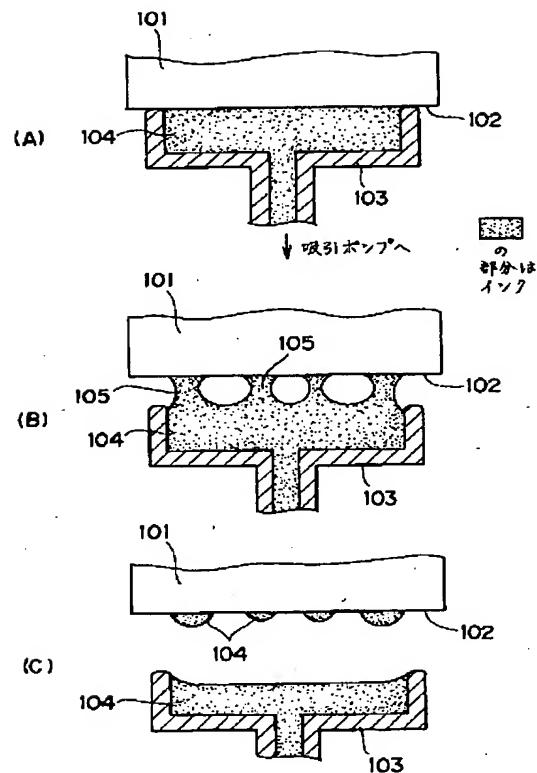


(34)

【図4-1】

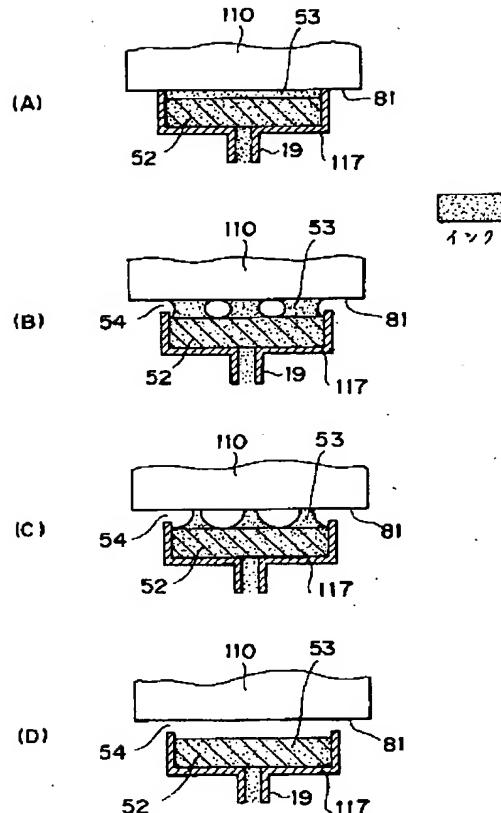


【図43】



(35)

【図44】



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